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T. COMMERFORD MARTIN and JOS. WETZLER, M. E., Editors.
WM. A. ROSENBAUM, Editor Patent Department.
WALTER T. HUNT, Advertising Department

New England Office, 8 Cook Building, Boston.
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VOL. XIV. NEW YORK, NOV. 23, 1889. No. 21.

Legislation on Safe Currents.

THE local representatives in the State Legislature have been urged by the New York *Morning Journal* to take up the subject of making currents safe, and it has invited them to a conference. They profess themselves ready for a crusade, though most of them do not appear to know just what to crusade about. As one of them remarks intelligently: "Edison says the subways will not be perfectly safe, but in this matter I shall be guided by what experts say."

Discussing Wires in Boston.

THE Boston Electric Club had an excellent meeting and dinner last week, when, following an ancient custom, the corpse of the New York Board of Electr cal Control was drawn around as a mute *objet d'instruction* to the festive members and their friends. It was a good idea to get the officials of the city together in this manner while the subject of overhead wires was so freely discussed, and it way be hoped that hasty, injurious action will thus be prevented. Some of the members were in favor of control, others were against, but none wanted such control as has been experienced in New York. Mr. Hovey's words were words of wisdom when he said: "Don't feel that the law is a panacea for all ills;" and we have realized in New York the force of his statement, that the legislation in such matters is generally wrong.

Subway Explosions

AMONG the dangers to which underground conduits for electric wires have been subject in this city and elsewhere are the explosions which occur from time to time, and which are usually ascribed to the ignition of illuminating gas mixed with air. Although this may possibly account for some of these occurrences, Prof. George Forbes, in an interesting letter, draws attention to another probable cause of these explosions. As but a very small leak induced by but a few volts difference of potential is sufficient to decompose water, Prof. Forbes infers that these explosions may be due to the ignition of the hydrogen and oxygen so formed. Either of the causes mentioned would be sufficient to explain the phenomena, and it is more than probable that they usually combine to effect the disagreeable results occasionally noted.

Birds and Liberty.

THE tender sympathies of many people were touched not long ago when the newspapers published accounts of the destruction of migratory birds by the Bartholdi Statue of Liberty, and some of us, for the sake of the birds, were willing to quench Liberty's torch. But, as shown by Mr. Dwight in our columns this week, the newspaper reports were wild exaggerations. At one time it was said 1,500 birds were killed and roasted, and at another 500 were reported as disposed of in a single night. The actual figures are given by Mr. Dwight, who shows that the number for the whole of the present year is below 700. It is a pity that even this number should thus dash themselves to death, but we would like to know how many more were shot in the New Jersey marches and sand dunes. Moths immolate themselves in gas jets by the million, but no one has yet urged that the gas be put out on that account.

Celestial Electro-Dynamics.

WHILE the laws of gravity are, no doubt, sufficient to explain the movements of the celestial bodies with respect to each other, other obscure actions have long been investigated, and the electro-dynamic theory is one which has often been suggested to account for them. It is, indeed, gaining ground for more than one reason. The beautiful experiments described in another column, due to M. Zenger, would seem, if not imitating fully the actions which take place, to at least afford a very striking analogy to them, and may possibly lead to the full establishment of the truth upon further investigation. In the light of these experiments, and in connection with the material properties of the electric current as now advocated principally by Dr. Lodge and expressed in his "Modern Views of Electricity," it would seem that the ether is not to be considered, as heretofore, the medium through which the force binding the celestial bodies to one another acts, but that it is the actual binding element itself, fulfilling all the properties of an incompressible, highly elastic fluid.

Gearing or No Gearing.

THE controversy which has long been going on in the field of steam engineering as to the relative advantages of slow-speed engines driving dynamos through the medium of counter shafting and belts, as against the high-speed engine geared direct to the dynamo, has its counterpart in recent attempts to employ direct driving for the motors of electric railway cars. Mr. William Baxter, Jr., well known for his work in the stationary motor field, has taken up this question and proved to his own satisfaction that the direct application of the motor to the axle leads to more economical results than in the employment of the high-speed motor on the car acting through intermediate gearing. We give Mr. Baxter's figures for what they are worth, as in the absence of actual experimental data it would be dangerous to compare the two except in a restricted way; but the methods employed by Mr. Baxter are sufficiently interesting to secure him a respectful hearing, and it is to be hoped that he will carry on his tests in order to demonstrate the truth of his claims.

Continuous Current Without Commutators.

WHEN, several weeks ago, we described the very ingenious methods of obtaining continuous current without the use of commutators, devised by Mr. Nikola Tesla, we were prepared for some attention, but hardly expected the interest which this publication seems to have aroused among electricians. The articles which we have already printed, and which were called out by our first publication on the subject, together with those that appear in our columns this week, are plain proof that this idea, which has lain dormant in the minds of many, is one which is specially attractive at the present time, and that some practical solution of the problem, if not already in existence, will soon be found. The methods described by Mr. E. E. Ries on another page, are of considerable interest, and are somewhat different from those employed by Mr. Tesla, so far as his work has been published. We have given considerable space to the subject on account of its evident interest to our readers, and can only add that this is again one of those remarkable coincidences, in which inventors have been laboring to accomplish the same idea independently of each other, and have arrived at the goal by analogous methods.

Travel Facilities in Cities.

THE subject of rapid transit in cities is one that more and more demands the attention of the press, but it is evident that in many quarters there is need for light on the part of those who influence public opinion. Thus, for example, in the course of an editorial on the subject of the cable road that the Mayor and Aldermen have approved of for Broadway, the New York *Herald* says: "Horse cars are destined soon to become conveyances of the past, just as slow stage coaches are of the past. The travel facilities of the future in large cities are rapid transit by steam and cable cars on surface roads. Give us both in New York as soon as possible, and make each system the best of its kind." The writer of this ought certainly to know that electricity has already proved a formidable and successful rival of steam and the cable, and that, in the official language of the street railway men in convention at Minneapolis last October, "it fills the bill to perfection." It is true that new cable roads are being put in, but relatively the cable is losing ground rapidly; and, while in New York we thus see the cable proposed to replace 1,800 horses, in Boston electricity already has been formally adopted to replace 8,000. Electricity is proving to be for urban traffic what steam has been for long-distance travel—the indispensable thing.

Electricity at Columbia College.

ELSEWHERE in our columns will be found mention of the meeting held last week at Columbia College by the New York Electrical Society. That event not only emphasized the new departure made by Columbia in establishing a course of electrical engineering, but is a sign of the times of peculiar value. There is always on the part of educational institutions a tendency to get set, to crystallize, to show fatty degeneration, to develop certain conditions that are prejudicial to life and movement. But Columbia College to-day is evidently laying her energies alongside the great problems and developments of the age and hour, and hence we find her taking up the latest and youngest of the professions and giving it a place and a welcome in her historic halls. The New York Electrical Society should felicitate itself upon the fact that her president is the first professor in charge of the Columbia electrical course. It is in such a reception as was given to the society last week, and in the course of Saturday lectures, that one sees on the part of Columbia a happy realization of the scope and meaning of the word "University." While the highest teaching for the students is not neglected, the ripe culture and keen intellect at her command are directed to the instruction of the people of the city. Out of such union, co-operation and extension none but the best results can flow, and we are delighted to see these friendly and helpful relations established between the Society and the College, which has given a very pleasant additional proof of its desire to promote electrical study and research.

The Heating of Wires.

EVER since the distribution of electricity began, and more particularly since its application to the lighting of private houses became an established fact, the question of the safe carrying capacity of wires has been one that has occupied the attention not only of the electrical engineer, but even more particularly that of the fire underwriter. As a result, various rules have been promulgated by different bodies, but the data upon which these rules have been based are for the most part indefinite. Though some of the rules are no doubt safe, they lack that foundation in actual experiment or experience which ought to be the basis of every applied rule. It is true that some attempt has been made to determine experimentally the laws of the heating of wires carrying current, and the work of Prof. Forbes and Mr. W. H. Preece is no doubt known to our readers through our columns. In the one case, however, the investigator reasoned from insufficient data, and in the other he confined himself to a few particulars, such as the determination of the fusing point of wires and one or two others. Up to within a short time no one has undertaken a systematic series of experiments embracing a large range of temperature with small intervals in order to verify the the laws heretofore established, which have been the basis of the present rules. This work, however, we are glad to say, has now been done, and to Mr. A. E. Kennelly, of the Edison Laboratory, the electrical profession is indebted for the valuable information which a long series of experiments, entailing much care and requiring much patience, has resulted in. In the first part of Mr. Kennelly's research, which we print on another page, he describes the general methods adopted in the tests for obtaining the temperature of the wire under different conditions of surroundings. The method employed, it will be noted, is an electrical one, in which the temperature coefficient of the wire being known, its temperature at various resistances is easily determined. In the succeeding parts, Mr. Kennelly describes various experiments on bare and covered wires of different qualities, under different conditions of use; and while confirming some of the older work in this respect, he removes various errors which have crept into it, due to the limited scope of the experiments previously undertaken. The article is of the utmost importance, and deserves the close attention of all interested in electrical distribution.

NEW BOOKS.

Woodhouse & Rawson Wiring Tables. Woodhouse & Rawson. London: 1889. Stiff covers.

Those who are engaged in the laying out of wiring for electrical distribution are in constant need of some method for figuring the size of the wires to be employed, and it is for them that the present tables have been designed. By their means may be found, by inspection, the size of cable to be used for a given current density, with a loss of potential, in the first place, of two volts, and again, for any given number of volts. By means of this table also there can be determined at a glance the cable to use for a given length and current, allowing a fall of two volts; and the current density when any cable is employed for a given current. The method of using the table is fully explained, so that, with little practice, very quick work can be done with its aid. The gauge used is the English standard, as employed in the cables made by the India Rubber, Gutta Percha and Telegraph Works Company, but by converting the sizes to thousandths of an inch, which can be very conveniently done, the table as it stands would be of considerable use even to American electrical engineers. The table is printed on linen paper and inclosed in stiff covers, so that it can be carried around with convenience.

Electricity in our Homes and Workshops. By Sydney F. Walker, M. I. E. E. London: Whittaker & Co., 1889. Cloth, 320 pp., 5 by 7 in. Price, $1.50.

The number of those who are taking up the study of electricity, and who are occupying their leisure moments with amateur electrical work, is constantly on the increase, and anything which can aid them is opportune. The work before us, though making no pretention to be a scientific exposé of the art, is well designed to lead to a more intimate knowledge of some of the everyday applications of it. It therefore begins very appropriately with a glossary of the terms used in works on electricity, defining the units and standards in a simple manner. The electric circuit is then taken up and the application of Ohm's law thoroughly discussed, together with the methods of insulation usually employed. It also treats of the magnetic effects produced by the current, which is further elaborated in the third chapter of the book, in which the various properties of magnets are clearly pointed out. The galvanic battery being still the principal source of electrical energy for the amateur, it is very appropriately treated in a chapter in which the various forms of batteries and their methods of mounting are pointed out. The remainder of the work is divided into three chapters devoted to a complete practical demonstration of the methods of construction and operation of electric bells, mining signals and telephonic apparatus, and the amateur will have no difficulty in mastering the various methods employed. The book is written by a practical man, and hence appeals strongly to those practically inclined. Numerous illustrations add to the value of the work for the beginner.

Thermodynamics, Heat Motors and Refrigerating Machines. By De Volson Wood, C.E., M.A., Professor of Engineering in Stevens Institute of Technology. Third Edition, Revised and Enlarged. New York: John Wiley & Sons, 1889. Cloth, 452 pp. 5½ × 9 in.

In our issue of Feb. 25, 1888, we reviewed the first edition of this work, which in this third edition has been enlarged to double its original size, 325 pages of new matter having been added.

In noticing the first edition, we called attention to the rare merit of the work, which consisted in retaining the spirit of Rankine, but detailing and simplifying the steps by which the master reached his conclusions, and by enforcing the lessons of the text with examples, problems and queries drawn from the large domain of actual practice and experience in steam engineering. The fact that a third edition has been called for so soon proves the correctness of our views and of our high appreciation of the original volume, and especially of the remark that "after having absorbed the contents of Professor Wood's book the student will find himself in possession of all he needs to know for any practical purpose on the subject of heat as a form of energy in practical mechanics."

Professor Wood, however, was evidently not content to leave the practical applications of the theoretical parts of thermodynamics to the individual student, but preferred, as a matter of illustration, completeness and presentation of valuable and recent data of experiment and experience in motor engineering, to add the special consideration of vapor, gas, naphtha and ammonia engines, steam injectors and turbines, compressed air engines, compressors and refrigerating machines. The same characteristics which we commended in the first edition in which the study of thermodynamics was associated more exclusively with the practical experiences of the steam engine are apparent in this work, where, in addition, the theory is applied to the other motors and heat machines named above.

Indeed, those who do not care for theoretical demonstrations will find so many facts relating to experimental records, actual efficiencies, etc., of engines and heat machines of various classes that they will value the book as a careful compilation of such data, embodying the digest of the latest records.

Although Prof. Wood does not touch upon the problems of thermo-electricity, the investigator in this field will find in the study of this work a mental equipment which will prove of unquestioned value for the development of this department of science. We cannot too highly commend this third edition of Prof. Wood's book to our readers.

The Mathematical Theory of Electricity and Magnetism. Vol. II. Magnetism and Electro-Dynamics. By H. W. Watson, D. Sc., F. R. S., and S. K. Burbury, M. A., Oxford. The Clarendon Press, 1889. 256 pp. cloth. 5½ × 9. Price, $2.75.

For those interested in the mathematical theory of electricity, the work of Clerk Maxwell will always be one of profound interest. The results which he obtained mathematically, independent almost of all experimental demonstration, will ever be considered as among the master pieces of mathematical investigation. Within quite recent times the correctness of the theories promulgated by Clerk Maxwell has been more and more confirmed, especially in the work of Hertz, in Germany, and Fitzgerald and Lodge, of Great Britain. Clerk Maxwell, however, in his giant strides, leaves the student far behind and in the dark as to the steps employed by him in passing from one part of the subject to another, and hence introduces difficulties in the way of a thorough comprehension of the subject. To such the present work will be of great assistance, for while following mainly the lines of thought laid down by Maxwell, the authors have filled up these gaps which leave so much to the student's imagination.

Beginning with the theory of Stokes, the authors pass on at once to the magnetic field, and discuss the theory of magnetism, magnetic potential and magnetic solenoids. The mutual relations of magnets and closed electrical currents, together with Faraday's law of induction, are then taken up, and the cycle of operations between the inducing current and the magnetic effect are thoroughly discussed. The succeeding chapters treat on the units of measurement and the ratio of the electrostatic and the electro-magnetic units, and the general equations of the electro-magnetic field. The electro-magnetic theory of light constitutes the

James Prescott Joule.

last chapter in the book, which is, perhaps, one of the most interesting in it, as the authors are enabled to compare theory with actual results, as obtained by Hertz, Lodge and others. The style of the work is throughout clear, but it requires considerable mathematical knowledge for its entire comprehension.

A Portrait of Dr. Joule.

A few weeks ago our London correspondent furnished an interesting biographical sketch of the late Dr. James Prescott Joule. We now have much pleasure in supplementing that by an excellent portrait of the great physicist. It is understood that a movement has been started in England to raise a monument to his memory, or to create some other lasting tribute to his genius, and we have no doubt that many Americans will be found among the contributors.

Continuous Currents without a Commutator.

BY T. D. LOCKWOOD.

In The Electrical World of Nov. 2, on page 290, is an interesting article entitled "Tesla's Method of Obtaining Direct from Alternating Currents without a Commutator."

Looking over this article, it struck me that the first paragraph is in some degree misleading; and, as it is an unsigned article, I have thought well to say a word that occurs to me.

Is it true, as stated, that "It is well known that the continuous current machine of to-day is one in which the currents generated are, as a rule, alternating currents, the direction of which is rectified by means of the commutator?"

I confess I should hardly have thought so. How about those of the many machines based upon the Gramme and Siemens types?

If one reads any printed description of the Gramme machine, only one idea can be formed concerning the direction of the currents; namely, that all of the individual coils on the ring armature, which at any moment are leaving one pole or approaching the other on one side, are practically engaged in developing an E. M. F. tending to produce a current in a given direction, while the coils on the opposite side of the ring approaching the first of said poles and leaving the second, are in like manner developing at the same moment an opposite E. M. F., thus tending to produce a current in *these* coils which opposes in direction those of the first set. Thus, were there no external circuit, the two opposing currents, being equal, would naturally neutralize each other.

But by the use of brushes constituting the terminals of an external circuit applied at the proper points of a revolving series of the armature coil terminals, the entire ring is made to act as two independent sources of electricity connected oppositely with respect to each other, but having an external circuit connected with them at the points between the two opposed plus and minus poles. It is thus a source having for its E. M. F. that due to the sum of the electromotive forces of one-half the number of the total coils, and having an internal resistance of one-fourth of that of the entire number of the said coils, if taken consecutively; and the combined current of the two sets of coils passes to the external circuit as one current of continuous direction, they being, in fact, at no time reversed or in any direction, but the same, when considered with eespect to the external circuit.

Certain it is, therefore, that there can no more be a question of alternating currents in machines of this type than there can be in the case of the two voltaic batteries of equal E. M. F., connected in parallel, which are generally employed as illustrations in text-book explanations of the Gramme machine.

But such machines have commutators? Yes, if you call a machine which continuously takes hold of one or more pairs of the generating coil terminals, and brings them, *always pointed in the same direction*, into contact with the line terminals. No, when considered in the sense of a machine which, at the moment the direction of current is reversed in a generator coil, reverses also the line terminal presented to said coil, taking one terminal away and substituting the other.

Indeed it is not difficult to remember that one of the alleged virtues of the Gramme machine when it was first introduced, and ever since, was that it generated continuous currents, and, therefore, needed no commutator.

Of course this is all ancient history, but it may be profitable to some, seeing that the constituency of The Electrical World is constantly increasing, and that few electrical men nowadays have time to study the history of the art, finding their time fully occupied in the living present.

Telephone Exchange Statistics.

The following are given as the figures of the world for telephone exchanges and subscribers:

The United States, 739 exchanges and 158,712 subscribers; Germany, 164 exchanges and 31,325 subscribers; England, 122 exchanges and 20,420 subscribers; Sweden, 137 exchanges and 12,864 subscribers; France, 28 exchanges and 9,847 subscribers; Switzerland, 71 exchanges and 7,626 subscribers; Russia, 36 exchanges and 7,589 subscribers; Italy, 28 exchanges and 6,183 subscribers; Belgium, 4,674 subscribers; Austro-Hungary, 4,200 subscribers; Norway, 21 exchanges and 3,930 subscribers; Holland, 9 exchanges and 2,872 subscribers; Spain, 2,218 subscribers; Denmark, 1,837 subscribers; Portugal, 2 exchanges and 890 subscribers. The city with the largest number of subscribers is Berlin, which has upward of 10,000, and is followed by New York, 8,000; Paris, with over 5,000, and London about that number.

Explosions in Underground Electric Conduits.

To the Editors of The Electrical World:

During the last six years a class of accident with underground electric conductors has been not infrequent in the United States, but the explanation hitherto given has not been satisfactory. It has been held that the explosive material was gas leaking from gas mains through the soil. The cause of ignition has been sometimes assumed to be lightning, but sometimes a fallen match. At the British Association meeting I suggested a more likely explanation. If there be water in the conduit and a leak in the insulation of the conductors, the water must be decomposed, an explosive mixture of oxygen and hydrogen given off, and as the level of the water falls (partly owing to decomposition, partly to draining), contact between the conductor and the water eventually is broken, with the inevitable spark. This must ignite any coal gas which may have found its way into the conduit, or in any case must ignite the products of electrical decomposition, oxygen and hydrogen. It will be interesting if any of your correspondents who have had experiences of these explosions can state whether any circumstances have been observed tending to support or to refute this explanation. It is a matter of great importance for engineers to know the sources of danger with which they have to deal. George Forbes.

London, Eng., Nov. 5, 1889.

Frosting Incandescent Lamp Bulbs.

BY F. DE L.

All the portable incandescent lamps used on the Pullman special trains have frosted or "ground" bulbs, prepared in the glass department of the Pullman Car Works by suspending the glass bulb in a solution of so-called "white acid" till the proper depth of glass is removed or dissolved Mr. A. H. Bauer has suggested the employment of the Planté process for securing delicate tracings on the lamps, and, in fact, on all the glass so treated and used in the coaches, namely, to cover the plate with a saturated solution of nitrate of potassium (pure saltpetre), and trace the design thereon with a finely-pointed platinum pencil connected to one pole of a storage battery, the other pole being connected to the plate. The white acid now employed can be most economically secured from any large drug house in quart leaden flasks, or it can be quickly prepared by slowly mixing equal parts of hydrofluoric acid and soft water in a leaden vessel, or possibly a rubber one, and allowing same to stand till cool, say ten to fifteen minutes. (Add the acid to the water, not the reverse.) Then carefully drop small particles of carbonate of ammonia into the solution till all foaming ceases, when the solution is ready for use. In using the preparation it is well to preserve the fingers from ill effects by anointing them with vaseline or some similar preparation. Another method of securing a temporary frosting on a globe, and one more simple and easy of operation, is to make a saturated solution of sulphate of magnesia (ordinarily known as "that horrible Epsom salts") in clear water; strain the solution to remove any minute particles of dirt, and then dip the bulbs therein, drying and dipping again, repeating the process two or three times till the desired effect is secured. As five cents' worth of Epsom salts will furnish solution to frost 100 lamps, it merely requires a little patience to secure the most beautiful effects, almost identical in appearance with the superior class of work furnished by Mr. J. Frost, of Blizzardville. But bulbs thus coated can only be used on one or two occasions, and must be handled with extreme care. For parties and receptions it answers the purpose nicely, and has an economical feature in that the solution costs practically nothing, and the frosting can be entirely removed by a moment's washing, thus leaving the glass clear for treatment with tints or otherwise. This solution of sulphate of magnesia may be tinted with the colors referred to by Mr. Huey in THE ELECTRICAL WORLD of Oct. 26, omitting the collodion and using colors that will dissolve in water.

A High-Speed Ship-Lighting Plant.

As our new navy progresses, continual demands are made by the Navy Department for increased efficiency in the electrical equipment of the ships, relating not only to the circuits, but to the dynamo and driving engine as well. To meet these demands in the building of a compact high-speed combined engine and dynamo, the Thomson-Houston Electric Company, in connection with the Armington-Sims Engine Company, at the request of the Navy Department, have produced the compact plant shown in the accompanying engraving, Fig. 1.

FIG. 2.

The dynamo as will be seen is a 4-pole machine of novel construction, the field magnets being built up of wrought-iron bars bent double so as to form consequent poles. The dynamo is attached directly to the shaft of the engine, and is capable of delivering 100 ampères at 80 volts.

A vertical engine was required, and the speed was to be 800 revolutions. This could be easily accomplished, but the principal requirement was that it should have an automatic governor, and that the regulation of speed should be as close as the standard engines of the Armington-Sims type. These conditions were realized in a vertical double, double-acting engine, which, like the horizontal engines of the same type, has both valves controlled by the automatic governor, and having the cranks opposite, so that the engine is perfectly balanced and can be run at a high speed. The engine has cylinders 5 inches in diameter by 3-inch stroke, and reaches a speed, when fully loaded, of 800 revolutions. The space occupied by the plant is: Width, 34 inches; length, 70 inches; height, 52 inches, and the total weight is 3,000 pounds.

The engine has been thoroughly tested, and when fully loaded, running at 800 revolutions, and removing instantly the whole load, the speed was increased but five revolutions, or a variation of but five-eighths of one per cent.

As a matter of interest we give a copy of an indicator card, Fig. 2, taken with full load at 800 revolutions. This will be of interest to engineers as showing the splendid admission and release of the steam at this high speed. It also shows the improvement that has been made in steam engine indicators to render the taking of a card at this high speed possible.

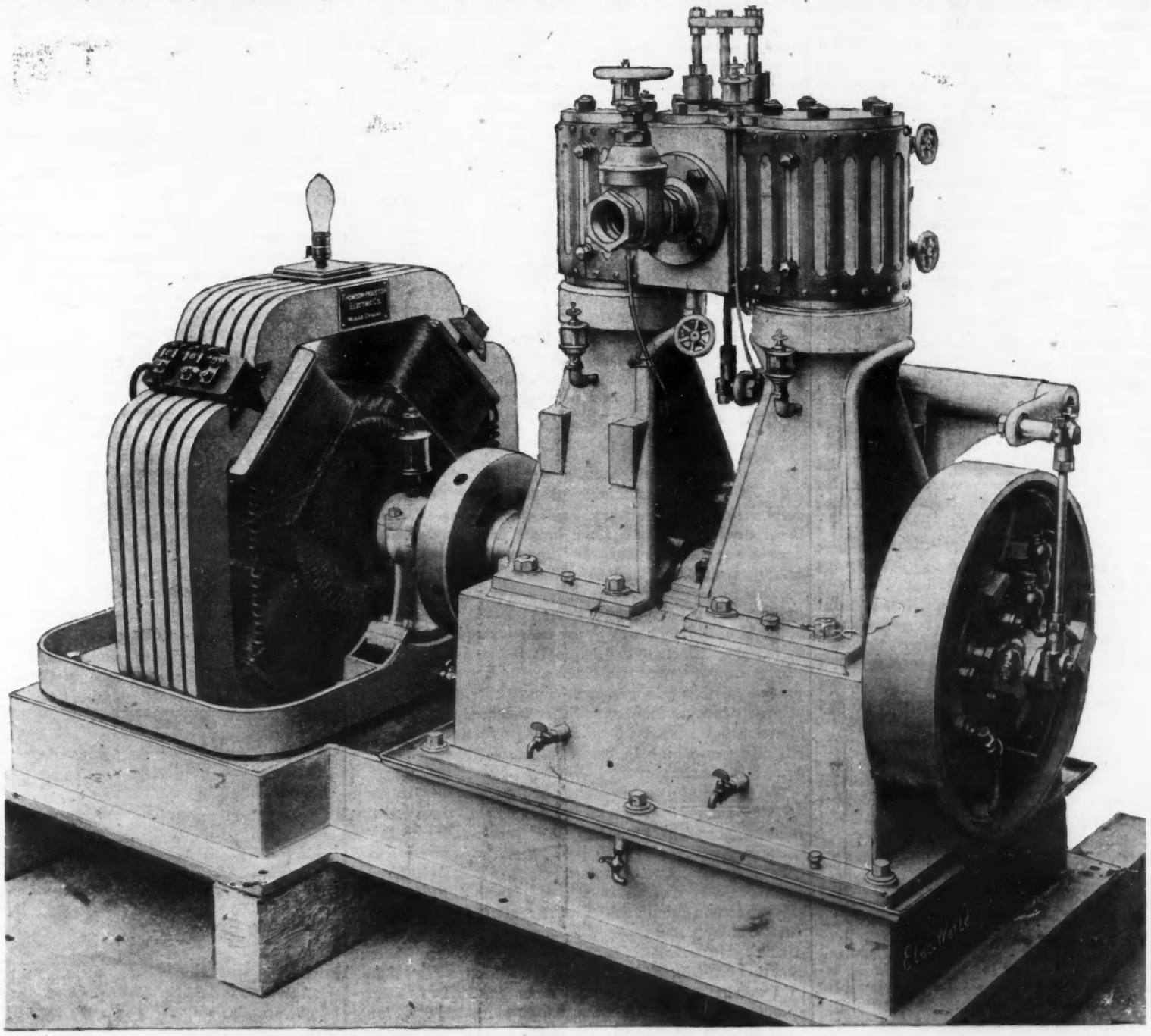


FIG. 1.—A NEW ELECTRIC LIGHTING PLANT FOR THE UNITED STATES NAVY.

The Hunter Electric Car Patents.

To the Editors of The Electrical World:

I have heard it stated a number of times that the Thomson-Houston Electric Company had bought out the Electric Car Company of America, which is organized under my patents on electric railways. As this is an entirely erroneous supposition, I would beg to make the following statement, that the position of the Electric Car Company might not be misunderstood. The Thomson-Houston Electric Company did purchase from the Electric Car Company of America, and from me, all the patents and inventions of mine which related to *line* conductor systems of electrical propulsion, and furthermore, the said company was licensed by the Electric Car Company of America and myself under various other patents, such, for instance, as car trucks, motors, electric heaters, etc., etc., which were applicable both to line conductor systems and storage battery cars. The Electric Car Company of America did not part with any of the patents which relate to the propulsion of cars by means of batteries carried by or with the car, and still maintains its exclusive title to my various patents upon this art, and which patents unquestionably control the system of propelling cars by means of batteries carried upon or moving with the car; and is actively engaged in the manufacture and equipment of railways with such cars. Aside from this transaction with the Electric Car Company and myself, the Thomson-Houston Electric Company also entered into an agreement with me personally in regard to other inventions of mine relating to their manufacture, thus identifying myself with their business. It will thus be seen that the sale and agreements which took place with the Thomson Houston Electric Company were such that it did not transfer to them any invention or improvement of mine relating to the propulsion of cars by means of batteries.

The Westinghouse Electric Company purchased an application of mine for the use of secondary generators as in general use, and they expect to sustain their position upon that application, which is now in interference with Bernstein, Carpentier & Deprez and Gaulard & Gibbs. It looks as if the decision will be in my favor. R. M. HUNTER.

PHILADELPHIA, Nov. 8, 1889.

On the Heating of Conductors by Electric Currents.*

BY A. E. KENNELLY.

I.

Although the best economical dimensions of a conductor employed to transmit power are determined by Sir William Thomson's law that that portion of the cost rate depending directly upon the cross sectional area of the conductor should equal the average cost rate of the power it absorbs in its duty, and although at the existing prices of copper and of power, such a conductor must be very heavily loaded to acquire a dangerously high temperature, yet not only may its limits of safe capacity be strained by occasional pressure, but it is well-known that in practice economy is not the only factor that determines a conductor's size, since the necessity, for example, of maintaining a constant difference of potential over an entire network of electric light mains under wide variations of load may sometimes clash with the conditions of economy in their transmission or even of safety in their temperatures.

Notwithstanding the consequent importance of a complete knowledge of the safe carrying capacity in conductors under all practical conditions of service, the subject has not, apparently, received the attention it deserves, and the simplicity of the law which determines the generation of heat in an active conductor, seems to have caused the complexity of the laws governing the dissipation of that heat and thus the limiting temperature, to escape the full notice of practical men. The most important published contributions to the subject appear in two papers, one by Mr. W. H. Preece, to the Royal Society, in March, 1888, and the other by Prof. G. Forbes, to the London Institution of Electrical Engineers (March, 1884). The former deals principally, however, with the fusing currents of wires for different metals and diameters, while the latter is almost exclusively devoted to the theoretical treatment of the subject. Had the experimental data of Professor Forbes' paper been as exhaustive as its mathematical investigation was complete, there would probably have been little left to add or amend from an engineering point of view; but the vital numerical coefficients it adopts are taken from experiments on the emission of heat, which, however accurate and valuable in themselves, are not fairly applicable to the conditions of conducting wires, and which, in their published form, tend rather to conceal than to elucidate the principles underlying the subject. The fact remains that none of the existing text books or tables up to the present date give with any pretension to accuracy the carrying capacity of wires consistent with safe temperatures, in clearly tabulated form, or any clear conception of the variation the limit undergoes with change of environment—empaneled, free, or out of doors. In addition to this, the rule of the British Board of Trade for installations within doors has been pointed out by Professor Forbes and others to be very uneconomical for small wires and actually unsafe for wires of a certain, though perhaps unusual, diameter.

To determine some of these unknown quantities, and particularly with a view to obtaining the necessary data for the fire insurance offices, the Edison Electric Light Company, of New York, recently instituted a series of experiments at the laboratory of Mr. T. A. Edison, in Orange, N. J., and with their permission the results obtained are now published. Not only have satisfactory general rules been arrived at for the safe carrying capacity of conductors, but the numerical coefficients in the formulæ given by Forbes

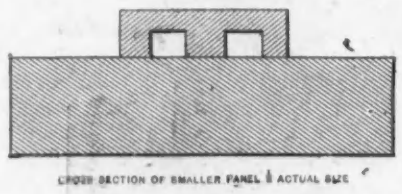


Fig. 1.

have been determined with a fair practical degree of accuracy, while the field has been opened for further useful investigation.

The experiments were made on conductors under three different conditions:

1. With insulated copper wires encased in wooden paneling to represent house wires.

2. With copper wires, both bare and covered, suspended on poles in the open air to represent overhead service.

3. With copper wires and strips suspended across a room to represent the conductors in an electric light station, and also to form a connecting link between the two previous conditions.

The elevation of temperature produced in the wires (whose conductivity varied from 97 to 101† per cent.) was in every case determined from the increase of their resistance observed after the experimental current had been passed through them sufficiently long to practically attain a limiting permanent temperature. This period of time was found to be about ten minutes with the paneled, and some two minutes with the suspended wires. With the former, a steady increase of resistance, which, according to theory would continue for all time, could be noticed for as much as thirty minutes, but it was estimated that the temperature elevation reached in ten minutes was 97 per cent. of its full ultimate value, and the greater accuracy attained by longer intervals of flow would not have repaid greater loss of time, especially as the quality of the wooden panel, its thickness, form and position, would practically involve commensurate variation in results.

It has been sometimes believed that the temperature elevation computed from the rise of resistance would be somewhat in defect owing to the gradient of temperature from the centre to the circumference, and the cooling of the external surface. Analysis shows, however, that this source

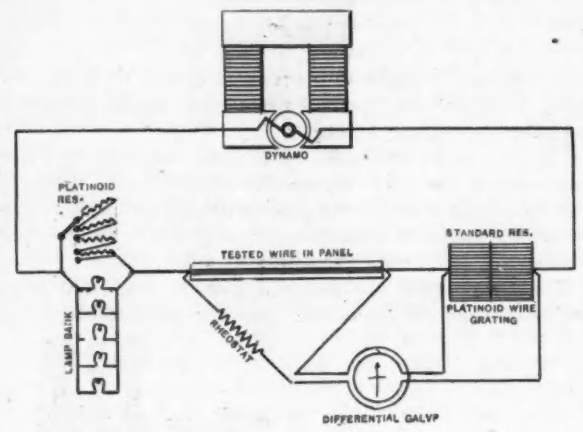


Fig. 3.

of error is too trivial to be taken into account, for if θ be the difference of temperature in degrees Cent. maintained in the permanent state between the axis of a wire and its exterior, then it will be found that

$$\theta = \frac{\rho}{JK}\left(\frac{C}{O}\right)^2;$$

where ρ is the resistivity of the wire,
C is the current it carries,
O is its circumference,
J is Joule's equivalent, or 42 megalergs,
K is the thermal conductivity of the metal,
all being expressed in absolute measure.

For a copper wire of one centimetre in circumference, carrying 100 ampères with $\rho = 2{,}000$ and $K = 1.1$, $\theta = \frac{1}{220}$ of 1 degree Cent.

EMPANELED WIRES.

Two 20-foot lengths of pine paneling were made of the cross sections represented in Figs. 1 and 2, and in all the tests these panels rested with their broad bases on the wooden floor of the testing room. In the smaller size, 12 wires, ranging from 0.0185 in. (0.047 centimetre) to 0.119 in. (0.302 centimetre) diameter, were successively tested, one side only of the panel being occupied at one time. In the larger size, 12 larger wires were tested, ranging from 0.119 in. (0.302 centimetres) to 0.445 in. (1.131 centimetres) diameter, generally two at one time, one in each compartment, so that the observations may be said to extend to diameters of nearly half an inch, or from wires whose resistance per metre varied from 0.019 ohm to 245 microhms at zero C. All the resistances in the tests are expressed in legal ohms (106.0 centimetres).

The increase in the resistance of the wires due to their heating was determined in the cases of all but the very smallest by that very accurate null method, in which the variable potential difference between the ends of the tested wire is balanced against the constant potential difference between the ends of an invariable platinoid resistance in the same main circuit, as shown diagrammatically in Fig. 3. This standard resistance was formed by a grid of 40 parallel platinoid wires, each eight feet (244 centimetres) long and 0.031 in. (0.079 centimetre) in diameter, stretched in a wooden frame between copper rods. The joint resistance of all these wires was 0.0499 ohm, and their large total surface of 374 sq. in. (2,410 square centimetres) and small coefficient of temperature variation (0.021 per cent. per degree C.) effectually maintained the resistance constant within at least 0.1 per cent. under all current strengths employed, especially as with the stronger currents the grid was connected with its two halves in multiple by letting the current enter at a third copper rod in the centre and divide among the forty wires on each side, the total resistance in this condition being 0.0121 ohm.

To balance the potential differences supplied by the wire and the grid, a dead beat differential mirror galvanometer was employed. It was carefully adjusted for differential perfection, until five volts connected with its coils in opposition series produced a barely perceptible deflection. The resistances and balance of the coils (about 2,700 ohms each) were observed before and after each test. During the observations one of these coils was connected with the paneled wire, and the other in opposition with the platinoid grid. The initial difference between the opposed currents thus acting on the needle when the first feeble current was sent through the main circuit, was reduced to vanishing point by inserting resistance in the circuit of preponderating influence. Under these conditions the resistance of the wire became determined, and its terminal potential difference exactly balanced on the galvanometer that from the grid. As the current in the main circuit was successively increased this balance became upset by the corresponding rise of temperature, resistance and terminal P. D. of the wire, necessitating readjustment of the inserted resistance, while the extent of this readjustment supplied all the data for the calculation of the change. This method was found to be very sensitive, and allowed the rise of temperature to be observed in a convenient manner for estimating the approach to limiting permanent state, while all slight variations of the dynamo testing current were eliminated, since their effect was equal and opposite on the galvanometer circuits. The temperature elevation was carried up to 100 degrees C. except in the case of the largest wires.

The strength of the current passing in the main circuit through wire and grid from the laboratory 110-volt dynamo was adjusted by platinoid resistances for the feebler currents, by banks of Edison lamps for the stronger and by a set of overhead wires for the strongest of all, the limit reached being 300 ampères. It was measured by means of a potentiometer, connected with the grid and also by at least one ammeter or dynamometer in the main circuit, whose readings were taken as a check upon the former. About one reading of the current per minute was observed, and the mean taken as that of the average current flowing during the period. The potentiometer employed its own working battery, mirror galvanometer and Clark standard cell. The potentiometer and ammeter are omitted in the diagram.

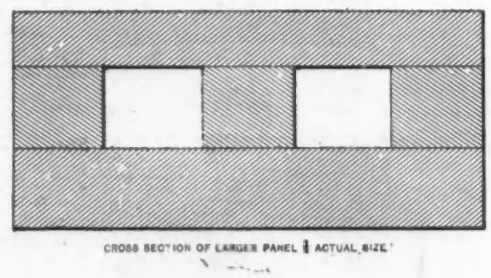


Fig. 2.

* Abstract of report read before the Edison Convention at Niagara Falls, August, 1889.

† Samples of copper offering a conductivity of as much as 104 per cent. of the original Mathiessen standard are stated to have been produced within the last few years, showing that the value of the standard needs revision under improved forms of chemical and mechanical treatment.

The Storage of Chemical Energy Electrically.

To the Editors of The Electrical World:

It gives me great pleasure to read the timely communication of Mr. Chas. J. Russell, as published in your issue of the 26th Oct. First, because it shows me that I am not the only one who is *ignorant* on the subject of storage batteries; and, secondly, and seriously, because it touches upon one of the fundamental principles involved in this much-discussed and vexed question of the so-called storage of electricity. There is no such thing as the storage of electricity in the sense in which it is commonly accepted. There is, however, the storage of chemical energy. For instance, to take the analogy of a reservoir being filled with water by a pump. Each stroke of the pump adds so much more water to the amount already in the reservoir, until the reservoir is filled and will contain no more. Before the pump was started the reservoir might have been empty, and if left to itself could give out no water if needed. But little by little the pump has filled it, and little by little it has been able to give, if required, more and more water, until when filled to overflowing it is able to give a constant flow of water for a considerable period of time. In a similar manner, as the water is stored in the reservoir by the pump, so is chemical energy stored in the storage battery. At the start it may be inert, its chemical relations fixed and stable, and it be incapable of giving off any electrical energy. A dynamo electric machine begins to pump electricity through it; little by little the chemical combinations which exist are broken up, and little by little chemical energy is stored up until the cell is said to be full; that is, all its chemical relations are changed until no further change can take place. At the start it could give out no electrical action, because it was in chemical equilibrium, but as the current of electricity acts upon it, by degrees its chemical balance is disturbed, and if left to itself it will do more or less work in restoring itself to chemical equilibrium, and in so doing give off more or less electrical energy. When the chemical equilibrium has been completely broken up it will then be in shape to do a maximum of work in recombining and attaining equilibrium as at first, and in so doing give off a maximum of electrical energy. This is what really takes place in every so-called secondary or storage battery, the storage of chemical energy, which, by transformation, gives us electrical manifestations. The line between primary and secondary batteries, as Mr. Russell states, is not sharply drawn; in fact, no such line really exists, for a *storage battery, or accumulator, is any combination capable of giving a current of electricity, which, when it is exhausted, can be renewed or regenerated by the action upon it of a current of electricity from some external source.*

E. R. Knowles, C. E.

The Hall Electric Pump.

In cities where the water pressure in the mains is low, it becomes necessary to provide pumps to fill tanks placed on the roofs, and in this city alone thousands of small engines of various kinds are employed for that purpose. The inconvenience attending their use, however, and their inapplicability in many situations has made some other type of motor desirable, and the electric motor meets admirably the conditions of a reliable and economical power. The installation of electric light plants in many small towns

THE HALL ELECTRIC PUMP.

with circuits extending out long distances in the outlying districts makes the electric motor also applicable for irrigation purposes, the watering of live stock, for fire purposes, etc. To meet the requirements of such cases, the Hall Electric Pump Company, of Plainfield, N. J., have recently brought out the combined motor and pump shown in the accompanying engraving. These pumps are connected with floats in tanks on the roofs of buildings and so arranged that the circuit is broken when the tank is filled; but when the water sinks below a certain level the float closes the circuit and starts the motor to work. In this way the supply tank is constantly kept filled without any attention whatever. One of these pumps can be seen in operation at the office of the Edison Illuminating Company on Fifth avenue, who recommend its use to their customers, and another is working at the Institute Fair.

The Baxter Electric Street Car Motor.

Since the practicability of electric railroads has been satisfactorily established inventors have bestowed considerable attention on the details of the car mechanism, and the manner of applying the motor to the driving of the axles has given rise to a large variety of arrangements. Among these the direct application of the motor to the driving axle, so as avoid all gearing, was early suggested, but, so far as we are aware, this method has not heretofore met with any practical success. The idea is a fascinating one, however, and our readers will be interested in a recent design of Mr. Wm. Baxter, Jr., of Baltimore, who claims to have solved the problem in a practical manner.

That this method is by no means one of easy accomplishment is apparent when we consider that in the present forms of geared truck the motor armatures revolve at from ten to twelve times the velocity of the car wheel axles, and that therefore their torque is only about one-tenth of that required of a motor attached directly to the axle.

If there were no objection to increasing the size and weight of the motors there would be no difficulty in accomplishing the result, but the size as well as the weight must be kept within certain limits, which are very restricted when the amount of work to be done is considered. When, in addition to the restriction in space and weight, we take into consideration the fact that the armature must rotate at a very low velocity, not over 70 revolutions per minute on an average, it is difficult to see how the requisite counter E. M. F. can be developed, unless the magnetic field is enormously strong and the turns on the armature are very great. But a very strong field and a great many turns on the armature mean excessive weight and high internal resistance, both of which are inadmissible. It is evident that the successful accomplishment of the result lies in producing a very strong field with the smallest possible weight, and a great many turns on the armature with very low internal resistance. This is what Mr. Baxter has done; he has obtained a very strong field in a very contracted space, and a great number of turns on the armature with a very low internal resistance and consequently high efficiency.

The low internal resistance is obtained by making the wires unusually large in cross-section, this increase in cross-section, as will be presently shown, being enough to enable the wires to carry the maximum current without dangerous overheating, so that there is no danger of burning out the armatures, even if the car is brought to a standstill and all the rheostat resistance is removed from the circuit.

The magnetic circuit in the whole motor, the field as well as the armature, is composed of wrought iron and the effective cross-sectional area is equal to about 60 square inches in the ordinary design of motors. The magnetic force that energizes the field has a maximum value of over 130,000 ampère feet. The ampère turns in the armature with the maximum current amount to about 160,000.

These figures correspond to the minimum velocity or maximum torque, which is about 1,100 pounds on the periphery of the car wheel for each motor. With this maximum torque the density of current in the armature and field wires is about six ampères per square millimetre. This is about double the current density ordinarily allowed in dynamos of the best construction, in which the heating effect of the current is very slight; and although this maximum current would heat the motors, very considerably if passed through them for a long time, it would, according to Mr. Baxter, not raise the temperature to a point high enough to injure the insulation.

In practice this maximum current seldom, if ever, passes through the motors, for as Mr. Baxter points out, if the armature rotates at all it will set up a counter E. M. F., and if it does not rotate, the rheostat would be in circuit, or at least part of it, so that from one cause or the other the current would always be kept below the maximum density. When the armature velocity is, say, seventy-five revolutions per minute, which corresponds to a car speed of about seven miles per hour, the efficiency of the motors is claimed to be over 90 per cent., and the current density is reduced to about one-tenth of the figures given above; that is, it becomes less than two-thirds of an ampère per square millimetre, which is very low, being about one-fifth the density allowed in first-class machines, and not enough to produce any noticeable change in temperature.

The magnetizing force, when the current is at a maximum, is about two and a half times that required to saturate the iron; but with an armature velocity of 75 revolutions per minute, the field is magnetized far below saturation.

The weight of each motor is about 650 pounds. The framing of the truck is very light, as it only needs to be strong enough to hold the axles in place. Together with the rheostat, which is located between the axles, it weighs about 200 pounds more than the framing used in the ordinary horse car to attach the running gear to the car body. A car provided with a two-motor truck will weigh about 1,500 pounds more than a horse car of the same size, its total weight being about 7,000 pounds. Such a car would be perfectly adapted to meet all the requirements of the average city railroads, as the following brief calculation will show: Mr. Baxter calculates that the greatest number of passengers that can be packed into, or on, a car is about 80 adults. Their weight (taking the average of men and women at 130 pounds, which is high,) would be 10,400 pounds. The total weight of the loaded car would, therefore, be 17,400 pounds. On a level the tractive force required to propel a car is about one per cent. of the weight; or, in the present case, 174 pounds. For each one per cent. of grade the tractive force required will increase 174 pounds. The maximum working torque of the two motors (that is, the torque at such a speed as would be required in ascending grades) is about 1,500 pounds. This, divided by 174, gives 8.57; which shows that these two motors would run the loaded car up grades of 7½ per cent.

In ninety-five roads out of every hundred, the grades are under five per cent.; therefore a two-motor truck would be suitable for all such roads. In the few places where there are very heavy grades, three, or even four, motor trucks could be used.

A one-motor truck would, according to Mr. Baxter, be ample for roads with grades of less than three per cent. and curves not under 40 feet radius. Thus, by placing one, two, three or four motors in the truck the power can be varied within very wide limits, wide enough to meet all practical requirements. As will be seen in the illustration, the motor is located in the back of the car wheel and is covered with a metallic casing, which is water-tight and made strong enough to hold the entire weight of the car; hence there is no danger of injury to the internal parts should the wheel strike any obstruction on the track; and as there is no machinery in an exposed position between the axles, there is no necessity of using a guard or "cow-catcher."

The velocity of the motor is so low that there is no difficulty in keeping the brushes and commutator in perfect order. There is no sparking, and all the evil effects of reversing the direction of rotation are removed.

The motors, in addition to being protected by a water-tight casing, are made waterproof, and could run under water if necessary.

The rheostat and starting switch are contained within a water-tight box located between the axles, as shown. This removes all obstruction from the platforms, and at the same time renders it possible to operate from either end of the car without the complication of two switches and rheostats. As there is no machinery under the car it is not necessary to raise the latter, and the height of the steps and platforms is the same as in the ordinary horse cars.

The car runs noiselessly, and the brushes, rubbing on the commutator, cannot produce the characteristic hum of the machine, because the velocity of rotation is entirely too low.

Mr. Baxter claims that the commercial efficiency of his system is much higher than that of any system in which the motors transmit motion to the axles by means of intermediate gearing of any kind. His calculations on this point are as follows:

The weight of a Baxter car is, say, 7,000 pounds. The weight of a geared car is, say, 11,000 pounds. The average load of a horse-car does not exceed 15 passengers. If we call it 20, and take the average weight at 125 pounds (which is high for the average of men, women and children), we have 2,500 pounds of passengers, which, added to the weight of the car, gives, for the Baxter car with average load, 9,500 pounds; for geared car, with average load, 13,500 pounds. In the Baxter car the power is applied directly to the axle, and the loss due to friction of gearing is saved. This loss, according to the experiments of Reckenzaun, is 15 per cent. Therefore $13{,}500 \div 84 \times 100$ gives the figures that represent the power required by the geared car to draw the average load, that is, 15,882.

If the average efficiency of the motors is taken at 80 per cent., which is not too low when it is considered that in turning curves and going up grades it must be much lower than this, it will require a relative electrical energy delivered to the car, which will be represented by the following figures:

For Baxter car, $9{,}500 \div 80 \times 100 = 11{,}875$.
" geared " $15{,}882 \div 80 \times 100 \div 19{,}852$.

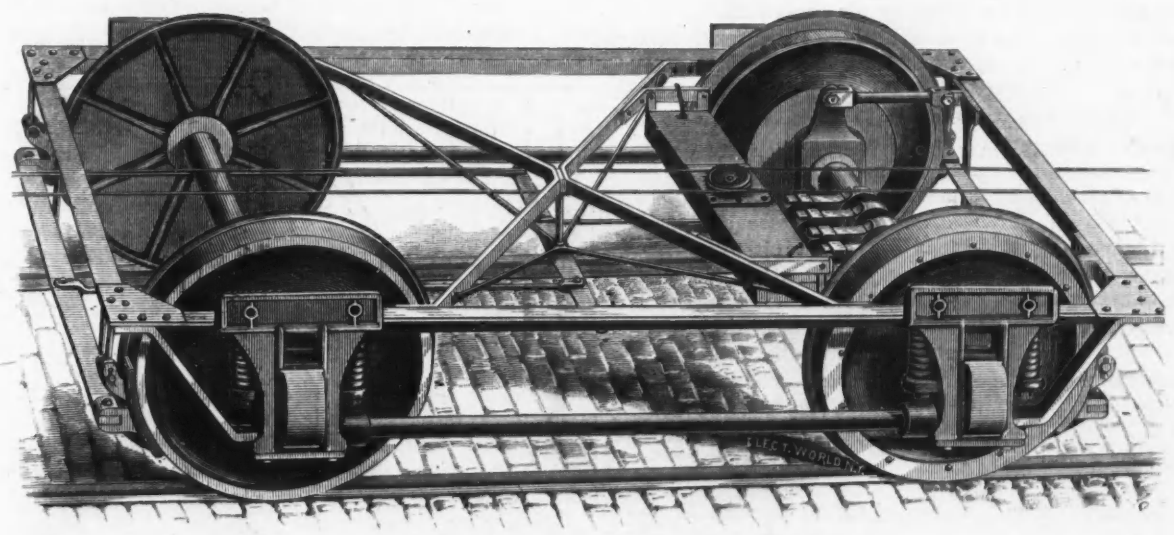
If the line loss is taken at ten per cent., the relative output of the dynamos will be:

For Baxter system, 11,875 + 10 per cent. = 13,062.
" geared " 19,852 + " = 21,837.

If the efficiency of the dynamos is 90 per cent. the steam engine capacity required will be:

For Baxter system, $13{,}062 \div 90 \times 100 = 14{,}513$.
" geared " $21{,}837 \div 90 \times 100 = 24{,}263$.

According to Mr. Baxter, therefore, the power required to run a Baxter car with an average load of 20 passengers is to the power required to run a geared car under the same conditions as 14,513 is to 24,263; or reduced to percentage, the Baxter system requires about 60 per cent. of the power used in the geared systems to do the same work.



THE BAXTER ELECTRIC CAR TRUCK.

Obtaining Continuous from Alternating Currents without Mechanical Commutators.

BY E. E. RIES.

Referring to the description of Mr. Tesla's method of obtaining direct from alternating currents in THE ELECTRICAL WORLD of Nov. 2, 1889, I would beg leave to state, without, however, wishing to detract anything from the credit due Mr. Tesla, that the various methods there described and illustrated are identical with some of my own work in this direction during the years 1886 and 1887.

My attention was first directed to this subject shortly before the introduction into this country of the alternating current transformer system of distribution, partly by a consideration of the possible injurious effects of the alternating current upon telephone and other circuits, and partly by the fact that alternating currents were not, at that time, adapted to the operation of electric motors, the charging of secondary batteries, and other operations requiring continuous currents. In order to combine the advantages offered by the alternating system, in the matter of generation, distribution and conversion, with those of the continuous current, I devised at that time, and explained to others, various methods, both mechanical and electrical, for carrying out this object in a simple and efficient manner, not only with respect to the obtaining of continuous current from alternating current circuits, but for the direct generation of high-tension continuous line-currents from alternating current apparatus, and for effecting various other results in electrical generation, transmission and conversion, and in the construction of apparatus to be used in connection therewith. The line of work upon which I was at that time engaged, however, and to which, for various reasons, I was obliged to devote most of my time and attention, did not permit me to prosecute the matter as actively as I should have desired, and I therefore found it necessary to lay it aside until a more favorable opportunity for taking it up presented itself.

Among the methods of "electrical commutation" first devised by me, were those represented substantially in Figs. 1, 2 and 3 of the article describing Mr. Tesla's invention, in which a continuous opposing or counter-electromotive, or electro-magnetic force, or an equivalent active opposing resistance or tendency, was set up against one or both sets of current waves, for the purpose of separating and directing them into their respective channels. These methods, however, I found to be open to objection, so far as their employment for continuous-current work was concerned, for the reason, first, that the currents flowing in the two branches were intermittent, or pulsating, instead of continuous, and second, that because of such intermittent flow the reactions set up within the circuit containing the generators of the counter current, if the battery in Fig. 1, or the magnet or converter coils in Fig, 2, (of the issue of Nov. 2, p. 290), are constantly in circuit, will seriously interfere with the satisfactory operation of the system, as well as lead to the consumption of a needless amount of opposing energy.

The last named difficulty can, I found, be obviated by the employment of a pulsatory or intermittent counter-force corresponding in periodicity to, and by preference derived from, the current which it is desired to commutate. In the system developed by the writer, however, the various difficulties referred to were avoided by dividing the + and — waves from *two separate sources* of alternating current, the waves of like sign from one source filling in the intervals between the similar waves or impulses from the other, in such a way as to produce a practically continuous flow of current over both circuits. In this manner the system was not only rendered applicable for obtaining continuous currents from alternating current circuits, as will hereinafter appear, but also for the direct generation of continuous currents from alternating current apparatus without the employment of mechanical commutating devices, and for the transmission of such continuous line currents and their reconversion into either alternating or continuous currents of any desired potential at distant points of consumption.

One form of apparatus devised by me for the direct generation of continuous currents, as above stated, consists of an alternating current dynamo having two armatures, or preferably a single armature provided with two separate sets of coils, so arranged that one armature or set of coils is half a period in advance of the other. The armature shaft carries two pairs of collecting rings, one for each armature winding, and the field is by preference separately excited.

An arrangement of this kind is shown diagrammatically in the accompanying Fig. 1, in which *B C* are the collecting rings or terminals of the two armature windings, *D D'* the points of connection with the two line circuits *F* and *G*, and *E E'* the generators of the counter force, which in this case is continuous in the direction shown by the arrows. The flow of current from each winding at a particular moment is shown by dotted arrow-heads, and the direction of the continuous currents on the line by full arrow-heads.

In the diagram a single separately excited field *A* is used for both armature windings, but it will be evident that two separate and independently excited alternating machines may be employed, provided that their armatures are mounted upon a common shaft or otherwise brought into proper step. In such case the machines may be used at will for alternating or continuous current work, as desired, by making the necessary circuit connections.

In Fig. 2 is shown a modified form of the apparatus represented in Fig. 1, in which the counter force is developed by the field magnetism of the machine itself. In this figure the translating devices are shown in parallel.

In order to apply this principle to the conversion of alternating line currents into continuous working currents, one method pursued was to divide the primary or secondary current into two branches and to insert in one of these a self-induction coil with adjustable core or other device to produce the necessary retardation or lag of half a period in the impulses of the current traversing it, preparatory to

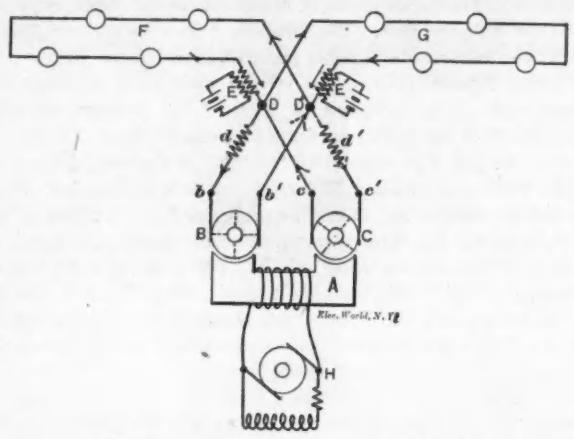


FIG. 1.—CONTINUOUS FROM ALTERNATING CURRENTS.

combining and directing the same as already described, or in one of several other ways. The electrical commutation of alternating line currents may also be attained by opposing intermittent or periodical counter force, either directly or by means of moving self-induction coils kept in unison with the alternating impulses.

Continuous line currents can likewise be converted into intermittent, pulsating or alternating currents without the employment of mechanical commutators, and various methods of accomplishing this have also been devised by the writer. One of the most simple plans is to divide the continuous current into two branches, in a manner similar to that indicated in Fig. 1 of the article describing Mr. Tesla's method, and either directly or by induction opposing to the current flowing in one or both of said branches an intermittent or alternating counter force. One advantage in the conversion of continuous into alternating currents by this method is that the number of alternations per second obtainable at the various transforming stations is not arbitrarily fixed; but as the rate depends entirely upon that of the opposing force employed at each station, any desired frequency may be obtained from the same circuit. It will also be apparent that the transmission of high-tension continuous currents as against high-tension alternating, possesses numerous economical and other advantages; all that has so far been wanting to establish this fact in a practical sense being a more simple and effective

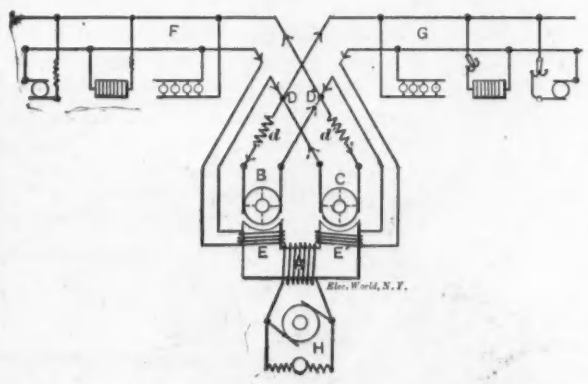


FIG. 2.—CONTINUOUS FROM AETERNATING CURRENTS.

method of generating and converting these currents than has hitherto been used or proposed.

Another and somewhat different method of generating alternating working from continuous line currents that may be mentioned in this connection is based upon a well-known principle in electrical generation. The advantage of this method lies in the fact that there is no connection between the two circuits, and that the current so generated may at the same time be of any desired electromotive force. For example, if a laminated core or field magnet be included in the high-tension line circuit, and a laminated armature having one or more closed coils be rotated by any suitable means in the field thus produced, an alternating current will be generated in the armature coils. The E. M. F. of this current will, of course, with a constant field strength, depend upon the winding and speed of the armature. This method is open to the objection that a separate source of power for rotating the armature or armatures is required, though for distributing centres running a number of circuits this objection need not hold. It is self-evident that the generated currents, if of low tension, may be straightened in the ordinary manner for continuous current work, if desired, and that the armatures may be combined with or driven by a separate motor supplied with current from the high-tension circuit, as distinguished from motor generators or continuous current transformers, in which the inducing and induced currents are brought into more intimate relationship.

Alternating currents may also be produced by means of two continuous currents, and, as already shown, continuous currents can be produced by two alternating or two intermittent currents. An alternating current may be superposed upon a continuous current, or a continuous upon an alternating, in such a way as to produce a pulsating or intermittent current, or, if desired, an undulating current having the waves of one sign predominating, any of which are capable of operating inductional apparatus. Pulsating or intermittent currents may, under certain conditions, be rendered substantially smooth or continuous by "toning down" or partially opposing or retarding the waves composing them. Pulsatory direct currents may be used for continuous current work in many instances without such retardation, as is well known, provided the translating devices themselves are of a sluggish nature.

A number of other methods for converting alternating into continuous currents and *vice versa*, in which opposing electromotive or electro-magnetic forces are employed, have been devised by the writer during the past few years, and form part of the general system of electrical generation, distribution and conversion referred to. Some of these relate to direct methods of generation and conversion of continuous currents without the aid of moving apparatus.

As stated in the article referred to, the applications to which the methods of electrical commutation described can be put are quite large, and I have already applied them in the designing of self-exciting alternating current generators and motors, both for stationary and electric railway work, in the construction and regulation of converters, to the charging of, and distribution of current from, accumulators, and to numerous other purposes, which it is not necessary to mention here. Perhaps the greatest advantage of the different methods above outlined is the facility they offer for the direct and economical generation, transmission and distribution of electrical energy, the ease with which the various kinds of translating devices can be interchanged and operated from a common source of energy, and the readiness with which the currents themselves can be converted, both with regard to each other and to the potential to which they may be raised or lowered. As already stated, my time has been taken up by other matters to such an extent that I have not been able to pursue this line of work to the extent that I desired, and the purpose of this communication is therefore simply to place upon record the result of some of my work in this direction, and the fact that the various methods of electrical commutation herein described and referred to were independently invented by me several years ago, without any knowledge of Mr. Tesla's work in the same line.

Spray Arrester for Secondary Batteries.

The different methods which are now in vogue for preventing the nuisance occasioned by this cause are all open to more or less objections. Glass plates require constant cleaning, and only partially effect their object; liquid oil is damaging to the plates if they should at any time be removed, and paraffine wax run over the top renders the plates altogether inaccessible. The new method, patented by Messrs. Drake and Gorham, consists of floating particles of a light substance on the acid to a depth of about ¼ inch. This is perfectly harmless to the battery, and can easily be pushed aside to enable the plates to be cleaned when necessary. Another advantage claimed is that the cost is considerably less than for glass slabs or paraffine wax.

Efficiency of Alternating Apparatus.

To the Editors of The Electrical World:

Please enlighten me through the columns of THE ELECTRICAL WORLD as regards the following questions: 1. What percentage of mechanical energy is absorbed by an alternating current dynamo when running at normal speed on "open secondary" circuit, primaries being closed through transformers? 2. What percentage of same is being utilized when running with primary open, with speed and exciting current normal as before, the machine being of the parallel type? 3. What portion or percentage of the original or normal power of a converter, of, say, 20 lights capacity, requiring two horse power, is still consumed in the primary circuit by induction and counter E. M. F., the secondary circuit being open? 4. What periodicity has the new Brush alternator per second? 5. Is either Sawyer or Man, of incandescent lamp fame, living yet? ALTERNATOR.

LYNN, MASS.

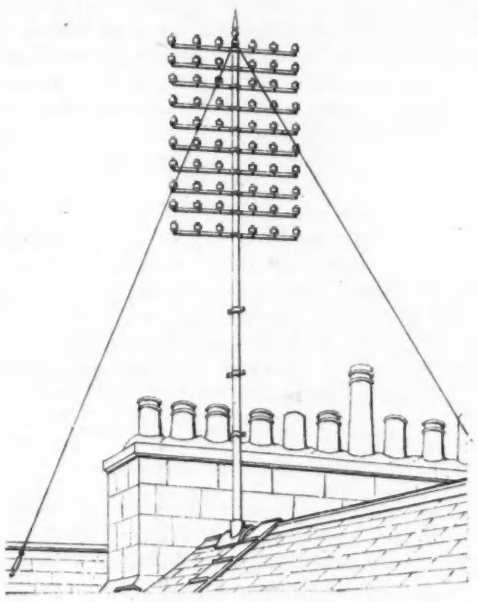
ANSWER.—1, 2 and 3. No reliable tests, so far as we are aware, have been made public involving these points. The losses in a converter due to various causes vary with the load. At full load, converters are claimed to have shown an efficiency reaching as high as 98 per cent. in some instances—that is, 2 per cent. loss. At partial loads the loss increases. 4. About 110 complete reversals per second. 5. Mr. Albon P. Man is still alive; Mr. W. E. Sawyer died several years ago.—EDS. E. W.

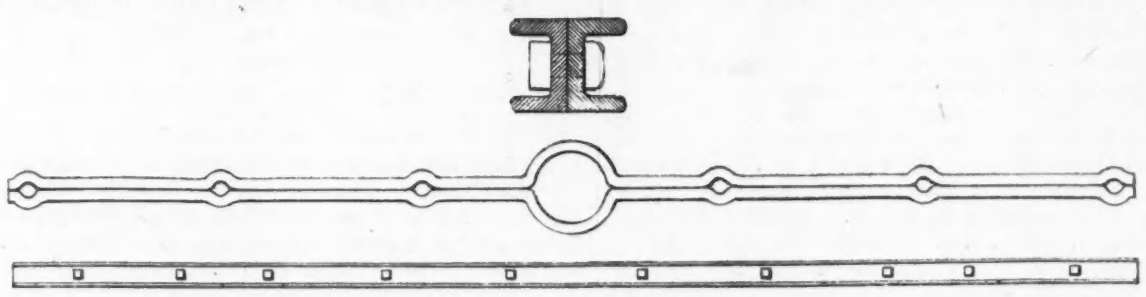
Telephone Line Construction in Scotland.

The recent letter of our special correspondent dated from Edinburgh gave some account of telephone line construction as practiced in Scotland, and the excellent work accomplished by Mr. A. R. Bennett, general manager of the National Telephone Company, whose lines cover the whole of Scotland, practically. The planting of poles in the streets being forbidden, it has become necessary to run the lines on the roofs of the houses; and as these are mostly of the gabled type, with very sloping roofs, the construction shown in the accompanying illustration, Fig. 1, has been adopted. The pole, it will be seen, rests on a cast-iron foot consisting of a semi-cylindrical base into which the upright pole of wrought iron fits. The pole, is guyed by two wires, and the whole makes a very stiff and neat arrangement.

The cross-arms upon the pole are made of wrought iron and in a very substantial and neat manner. Our illustration, Fig. 2, shows the arm in section, and Figs. 3 and 4, respectively, a plan and elevation of the same. As will be seen, it consists of two channel iron bars, 1¼ inch wide, which are shaped to fit the tube and insulator bolts by hydraulic pressure applied cold. Two of these bars, which are counterparts of each other, are then bolted together encircling the pole, and the insulators inserted into the holes provided for them. The tightening of the bolts effectually clamps the arm to the pole, so that no twisting occurs.

This type of pole and cross-arm were designed by Mr. A. R. Bennett several years ago, and to him is also due the design of the insulator, which is shown in elevation and in section, respectively, in Figs. 5 and 6. This insulator was designed specially for telephone work, and, as will be seen, consists of a porcelain body with a number of corrugations





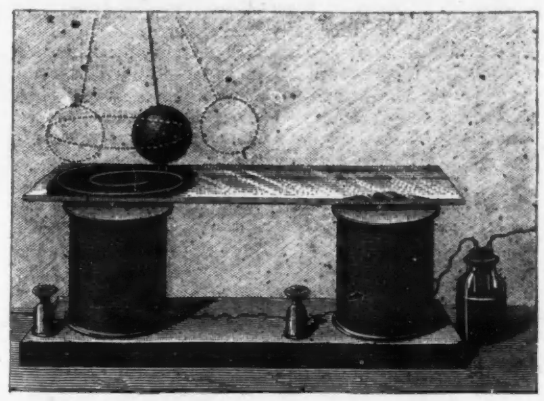
FIGS. 1, 2, 3 AND 4.—TELEPHONE LINE CONSTRUCTION IN EDINBURGH.

into which is imbedded the pin. This form of insulator enables several spurs or legs to be taken off the wire at any point with great readiness, and also resists stone throwing successfully to a much greater extent than the usual Post Office pattern insulator used in England. It is evident, also, that from the increased amount of surface presented by the corrugations the insulation is necessarily higher than would be the case with a plain cylindrical insulator; and as the pole and cross-arms are of iron, instead of wood, it is evident that a good insulator is absolutely necessary on these lines, and the one designed by Mr. Bennett has fully equaled the requirements. The insulator has also been found to give excellent results for telegraph and electric light purposes.

Explaining the Movement of the Celestial Bodies by Electro-Dynamic Laws.

In a communication made to the French Academy of Sciences as far back as 1884, M. Charles V. Zenger traced a certain definite relation between the times of rotation of the sun upon its axis and that of the planets. In following out this idea, M. Zenger has been led to the conclusion that the remarkable relations which exist can be explained by assuming an electro-dynamic action not only between the sun and the various planets of the solar system, but also between the planets and their satellites. These actions can be demonstrated experimentally by means of the electro-dynamic autograph designed by M. Zenger and constructed by M. Pelin. This instrument, which is illustrated in the accompanying engraving, taken from *La Nature*, consists of an electro-magnet wound with two bobbins about 150 millimetres high and between 50 and 60 millimetres in diameter. One of these bobbins is fixed and the other is movable on a soft iron rail, so as to neutralize the action of the two poles. Above the two coils there is placed a smoked glass plate, and over all is a copper ball separated from the magnet by the plate.

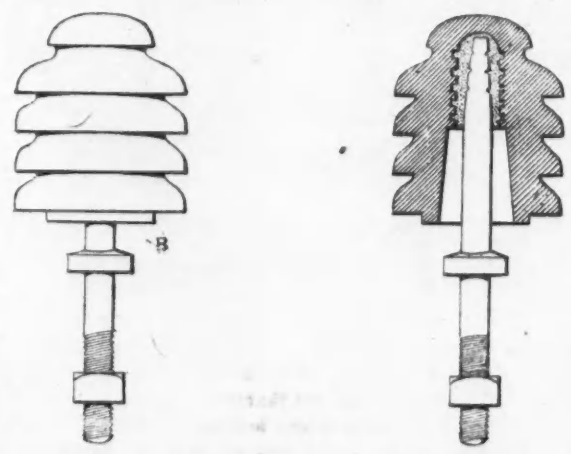
In order to repeat the experiments originally made by M. Puluj, M. Zenger suspends the ball above the centre of the fixed bobbin in the line of its magnetic axis. By turning the ball with the hand the suspension thread is given a twist, but without changing its vertical position; when freed again, the ball of itself turns in a direction opposite to the movement which has been imparted to it, as is quite natural. Now, at the same time that this movement commences, M. Zenger passes the current into this bobbin without passing it into the other one. Immediately the ball stops, which, of course, follows as a matter of necessity. In fact, it is



ELECTRO-DYNAMIC LAWS AND THE HEAVENLY BODIES.

easy to understand that its movement is stopped by the inverse action of the lines of force on each of the two hemispheres. This beautiful experiment is a corollary to Faraday's well-known experiments, and to that of Léon Foucault. The resistances being symmetrical with relation to the axis of rotation, they produce arrested motion; but when they cease to be symmetrical they produce the effect of lateral forces resulting from the lines of force and combine with the action of gravity. On this hypothesis the sphere will be deflected from its vertical position, and in such a way as to take up an orbital movement.

Two principle cases can be distinguished. 1. By submitting the sphere to a unipolar induction; that is, by displacing the point of suspension and by giving it the position indicated in the accompanying illustration. When the ball is abandoned to itself—having been previously put into rotation—it is deflected progressively from the axis, and describes with a decreasing speed of revolution a spiral, the rings of which spread progressively, while constantly approaching each other, so as to approach a circular form, the diameter of which depends upon the strength of the magnetic field and upon the weight of the ball; while decreasing, the speed of revolution approaches a constant limit, which it attains when the spiral approaches the circular form. In order to show these movements graphically, M. Zenger provides the bottom of the ball with an elastic point, which, being always in contact with the smoked glass plate, traces the spiral figures shown in the illustration. If the sphere be under the influence of a bi-polar induction, and suspended symmetrically with respect to the two bobbins, the stylus traces a circular spiral. If the ball be placed nearer to the north pole, the stylus traces an elliptical figure, the major axis of which is the N. S. direction. In order that this action may take place, it is necessary that at the moment of starting, the centre of the ball be in the same vertical plane as the N. S. line. It is evident that the eccentricity of the ellipse is a function of the intensity of the magnetic field and of the distance of the ball from each of the two poles.



FIGS 5 AND 6.—THE BENNETT INSULATOR.

If we approach a third magnetic field, it is evident that the elements of the elliptical movement will be subject to perturbations, and hence the most diverse figures can be obtained. These become the more irregular the more the action of the third magnetic field increases in power. By placing the perturbing field in proper positions, there are obtained upon the plate curves resembling very much the orbits of the smaller planets. If this third field is sufficiently powerful there are obtained orbits which are greatly changed, presenting points of inflection and nodes similar to those presented in the movements of the satellites and the systems of triple stars which are physically connected with one another.

M. Zenger remarks that it is remarkable that these phenomena furnish a very simple theory for cases so difficult to explain, and which astronomers are always prone to attribute to errors of observation. In a communication made by Mr. Sherman this year to the National Academy of Sciences in Washington, he showed that the variation in the time of revolutions of Encke's comet coincided with the eleven-year period of activity of the sun-spots and their accompanying magnetic effects. It is thus, says M. Zenger, that the action of universal attraction at a distance can be explained by the electro-dynamic action of two curents, or by magnetic action at a distance, and that we may consider the electric radiation of the sun and planets as the fundamental cause of the celestial movements.

Electric Fog-Signaling Apparatus.

A new fog-signaling apparatus has lately been perfected in England which is of sufficient merit to attract the attention of all those interested in the saving of life and property at sea. It calls into use electricity, which admits of the signals being automatically worked and at the same time records every signal as it is given on a band of graduated paper. This paper forms a complete register of the signals, and is documentary evidence in case of dispute as to whether or not a vessel was signaling when a collision occurred.

The apparatus consists of a single switch, which is placed on the vessel's bridge, so that the signaling can be controlled by the officer on watch. When it is desired to blow the signal whistle or to begin the automatic signaling, whatever its nature may be, the lever is turned to the "under way" notch if the vessel be moving, and the electric current at once begins working the valve of the steam whistle at regular intervals, conforming to what the law specifies. Should the vessel be at anchor the switch is turned to "at anchor," and the bell is rung in the same way. The register consists of the band of paper properly subdivided and moved along by clockwork. A traveling pointer, actuated by an electro-magnet, pricks the paper at every sound of the bell or whistle. The signaling can also be made at will entirely independent of the automatic mechanism by simply pressing a button, which closes the circuit leading to the bell or whistle.

Domestic Electric Lighting by Primary Battery.

At the invitation of the Self Generating Electric Light and Power Company, of this city, we took the opportunity last week of inspecting the domestic electric lighting plant operated by that company, consisting of a primary battery, of novel construction, designed by Prof. P. R. F. D'Humy. The battery is in the form of a cabinet, and two types are employed, in one of which the positive element is an alloy of zinc and in the other iron. The electrodes are placed in a cell having porous plate partitions, the iron or zinc alloy being placed in a dilute solution of sulphuric acid, while the negative electrode, of carbon, is immersed in a concentrated nitric acid solution. The arrangements for emptying and refilling the cells are very complete, and it is claimed that they will operate a long time without attention. Several of these cabinet batteries were shown in connection with storage batteries which they charged, and which supplied current for a number of lamps. A motor was also shown in operation driven from the battery.

We were also shown the method of manufacture of the cells in which the plates are contained. These consist of wooden boxes which are made impervious to the attack of the acids by a coating of insulating material, which is effected by immersion in a bath consisting of a mixture of asphalt and other substances. The battery for an ordinary-sized house occupies no more space than an upright piano, and is capable of furnishing current for 20 lamps of 16 c. p., and it is claimed that light can thus be produced much cheaper than by gas.

Sparkless Electro-Magnets.

A communication by Prof. S. P. Thompson to the Newcastle meeting of the British Association referred to the various devices suggested to destroy the sparking of electro-magnets, and to comparative tests on the merits of five types of such coils. As the various windings did not permit of always using the same number of turns, the respective currents were adjusted so as to produce the same deflection of the magnetometer. The first coil had eight layers of No. 18 B. W. G. wire with 646 turns; the core of the second was surrounded by a copper sheath, an old suggestion of Cromwell Varley's; the layers of the third were separated by cylinders of tinfoil; the fourth was differentially wound in two circuits, magnetization taking place when the second circuit is opened; the fifth was one of Mr. Langdon Davies' coils with fifteen layers, which were wound separately, starting from the same end always. The order of merit of these coils Professor Thompson judges to be: No. 2 by far the best; then No. 5; further behind No. 4; then No. 3 with hardly any effect, and finally No. 1.

Electricity and Church Music.

Among the many applications of electricity, there is probably none, outside of the electric light and power and the telegraph and telephone, that presents more interesting features to the electrician, as well as to the layman, than its application to the action of church organs. We do not refer here to the electric motor for blowing organs, which has lately come into general favor, and deservedly so, but to the electric playing, *i. e.*, the electric connections between the keys and the pipe-valves, as against the old and familiar mechanical connections by "trackers," "rollers," "squares," "levers," etc.

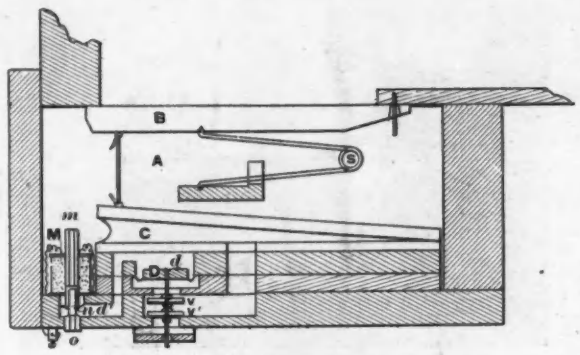
Up to a few years ago the product of mere dilettantism, conceived and executed without any regard to electrical laws, or in blissful ignorance thereof, resulted in electric organs which were rightfully considered toys, pretty playthings, which, although having their merits in affording the means for the production of musical effects not possible before, could not command any serious consideration, on account of their comparative unreliability. To-day this branch of the organ-building art, brought to practical shape and founded on a strictly scientific basis in the system of Mr. G. Wacker, of this city, not only competes successfully with the old style of action, but is considered even by conservative men, who a short time ago did not deem electric action worthy of any serious notice, as superior to the old method in every respect. A case in point is the large new organ for St. James' Cathedral in Toronto, Ont., now in course of construction. It having been decided to place one of the four manuals of the instrument at a considerable distance from the others, electric action had to be resorted to in order to connect that part with the keys at the other end of the church. The head of the contracting firm, Messrs. S. R. Warren & Son, organ builders, of Toronto, accordingly went to England to investigate the work done in that line there and eventually to contract for the electric parts. The results of this trip were rather disappointing, Mr. Warren not being able to find an electric organ that would come up to his idea of reliability. He next came to New York to examine the "Wacker" action, and the result of this investigation is that now not only the detached part of the new organ, but all the other parts, will be played by electric action. Mr. Warren came to the conclusion that no mechanical action, however well and carefully made, would withstand the changes of weather and temperature for years without requiring any attention or regulating as the Wacker electric action does; while, on the other hand, its promptness, its freedom from "sticking," its easy "touch" cannot be reached by the best mechanical action.

The accompanying illustration shows the new form of the Wacker electric organ action. Here *A* represents the usual wind chest, which is filled with compressed air from the organ bellows, the pipe valve *B* being kept closed by the spring *S*, and *C* is a "pneumatic lever" connected by a link or hook to the valve *B*. The main feature of the action is the Wacker electro-magnet *M*, which has a hollow core *m*. The armature to this magnet, *n*, is perfectly independent, and normally rests upon the apertured plug *o*. The diaphragm *D* forms one of the walls of the chamber *d*, which is in connection with the wind chest *A* through the channel *d'*, the annular space around the armature *n*, and the hollow core *m*. The diaphragm *D*, as will be noted, carries a valve stem to which are attached the valves *V* and *V'*.

The operation is as follows: In the position shown, the apparatus is at rest, with the pipe-valve *B* closed; the interior of the pneumatic lever *C* and the chamber of the diaphragm *D* are then under the same air pressure as the chest *A*. Where the key on the manual is depressed, a current is sent through the magnet *M*, which causes the armature *n* to rise, thereby closing the tubular core *m* and opening the plug *o*. The interior of the chamber *d* being thus connected with the outside air, the diaphragm *D* is forced upward by the air-pressure in the windchest, thereby raising the stem and closing valve *V* and opening valve *V'*. This brings the interior of the pneumatic lever *C* in connection with the outside air, causing *C* to collapse under the pressure on its exterior, and thereby opening the pipe-valve *B*. The breaking of the circuit causes all the parts to resume their former position. The arrangement works instantaneously, indeed much quicker than is ever required for organ-playing.

In order to avoid the use of batteries for the operation of the electric action, Mr. Wacker has designed a small constant potential machine delivering current at from 8 to 10 volts, the weight of which for the largest organs does not exceed 20 pounds.

There are interesting electric plants in miniature in some churches in the city of New York; for instance, in the



Wacker's Electric Organ Action.

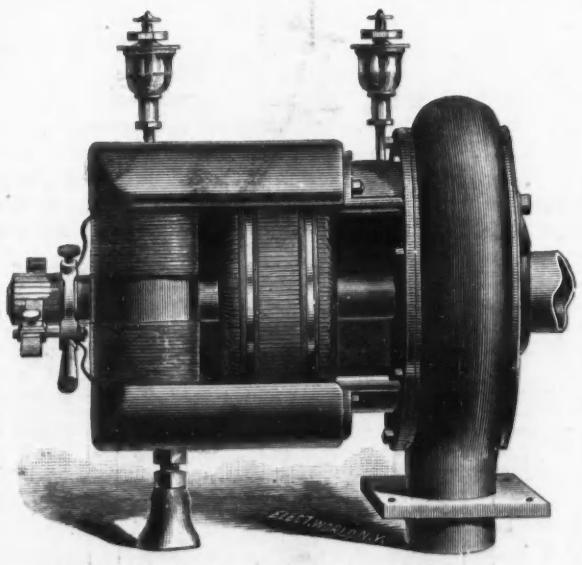
Church of the Holy Trinity, Forty-second street and Madison avenue. This plant consists of a gas engine of ⅓ h. p., a small dynamo, a storage battery, the necessary automatic cut-outs and automatic battery switch.

Another such plant is in St. George's Church, corner of Sixteenth street and Stuyvesant Square, with a steam engine of ¼ h. p. and a dynamo of about 100 watts capacity. The organs combined by Wacker's electro-action in St. George's Church form the largest instrument in New York, numbering over 80 speaking stops. It might incidentally be remarked that the combined length of insulated wire used in this instrument is over 37½ miles. There are 438 electro-magnets, and as many individual lines of an average length of about 200 feet from the keys to the valves. This instrument has been played electrically for nearly three years without showing any defect whatsoever, either in the generating plant or in the "action" proper.

This idea of equipping churches electrically in all the details is gaining in favor all over the country, and the time seems not far distant when an electrician will be as well recognized an adjunct to every church as the parson himself.

The Belknap Water Motor and Dynamo Combined.

The tendency in building modern machinery seems to be towards compactness, and of this tendency the apparatus illustrated below is a good and practical example. Electric lighting plants for use on shipboard must be compact, and therefore we find numerous contrivances of dynamo and engine on the same shaft. Where pumping machinery run by the electric motor is extensively used there is an immediate demand for a motor and pump combined, just as



The Belknap Water Motor and Dynamo.

duplex pumps are of steam and water cylinders combined. There is certainly a field for a water motor and dynamo combined, and it is this field that the Belknap water motor is designed to cover. The apparatus is shown so clearly in the accompanying illustration as to need little explanation. The covered section of the apparatus shown at the right of the cut is a water wheel into which the water is conveyed by the horizontal pipe shown as broken off, and is drawn off by the vertical pipe below. On the same shaft, and in the same covered machine, is the armature rotating between the fields shown in the illustration. It is claimed that this apparatus needs only the attention due to the commutator and brushes of any dynamo or motor and the periodical filling of the oil cups. Wherever a moderate economical water supply is available with sufficient head, there this water motor is an isolated incandescent plant in itself. These outfits are manufactured to run from 10 lights up to 100 and more, and have thus far given satisfaction. Where power is required in the day time and light at night, the machine can be fitted with a pulley on the motor shaft to run direct to a main line of shafting in the day time; thus a grocer may grind coffee in the day time, lifting up the brushes, and light his place at night, with one and the same motor. The principal demand for an inexpensive plant of this type is naturally from residences, offices, stores, factories, hotels, halls and churches, and it bids fair to prove particularly economical where intermittent and variable service is required. Where the water pressure is low a specially constructed chute is used; otherwise a maintained pressure of 60 pounds to the square inch is sufficient to bring the armature up to speed. If this water motor continue to give satisfactory results without developing serious mechanical or electrical defects, it will no doubt do what the primary battery enthusiasts have so ardently longed for—produce light for dwellings with a minimum of care and attendance. The combination is built by the Belknap Water Motor Company, of Portland, Me.

Dr. Green and the New Government Telegraph Rates.

Under date of Nov. 12, President Green, of the Western Union Telegraph Company, wrote Postmaster-General Wanamaker protesting against the rate for government telegrams fixed by the Postmaster-General's official order of Oct. 30, and inclosing a copy of the preamble and resolutions adopted by the Executive Committee of the Board of Directors after due consideration of the order of Oct. 30. The preamble recites that "whereas this company is obliged to consider the enforcement of said rates as a confiscation of its property to that extent, and is advised that obvious injustice under said act is remediable at law.

"*Resolved*, That this company will transmit, as heretofore, with due priority and diligence, all telegrams between the several departments of the Government and their officers and agents; but this company will not accept as final payment the rates above established until its rights in that regard have received such further consideration as it may be able to secure; and the president of this company is hereby directed to file a copy of this, our protest, with the heads of the several executive departments of the United States."

After stating that the order of Oct. 30 makes an average reduction of a fraction over 40 per cent. from the rates fixed last year, which were not remunerative, Dr. Green says: "If the entire message business of this company for the fiscal year just closed had been sent at the rates named in your last circular, our total receipts from that source would have been about $4.000,000 less than the actual cost to us of transacting that business."

Electrically Welded Rails.

In regard to this very interesting subject, Mr. Elias E. Ries, of Baltimore, in a letter to the *Street Railway Journal* says: "My attention has been called to an interview between your representative and the superintendent of the Third Avenue Company's lines (New York City), published in your September issue, in the course of which reference is made to the employment of electric welding as a remedy for the severe pounding and other troubles experienced on the 125th street cable road by reason of the usual defective rail joints.

"The objection seems to have been based upon an error, in asssuming that in the continuous or electrically-welded rails no provision is made for expansion and contraction. A change in temperature of 25 degrees, which is above the usual maximum variation occurring within the limits of a day of 24 hours in this latitude, can only produce a movement of one-half an inch at the extremities of each 500-foot rail section, which, of course, is doubled for the thousand-foot lengths.

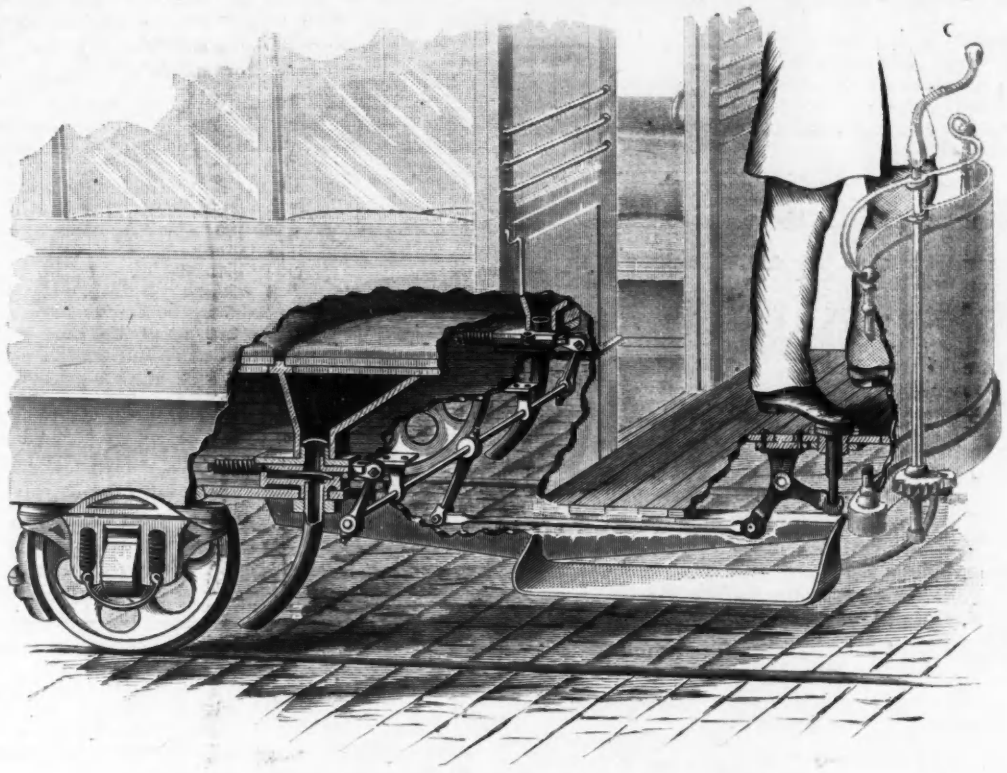
"It will be apparent that some means are required to compensate for the variations in the rail lengths and to render the rail surface continuous. This is effected in a very simple manner by means of divided 'expansion joints' of special construction. These comprise a rigid elongated chair, provided with a self-cleaning groove to receive and guide the ends of two adjoining rail sections, the extremities of the rails being faced off on opposite sides so as to partially overlap each other. The arrangement is such as to provide for the maximum variation that can take place, and yet leave the rail surface of the entire line continuous and unbroken, so that the passage of a car from one rail section to the next cannot be detected."

Birds and the Liberty Statue.

At the meeting of the American Ornithologists' Union, in this city last week, Jonathan Dwight, Jr., read an interesting paper on "Birds that have Struck the Statue of Liberty, Bedlow's Island, New York Harbor." He said that on account of its lighter color more birds strike the pedestal to the statue than the statue itself. The statue was erected too late in 1886 for the migratory birds, and none struck it that year. The first to strike it was May 19, 1887, and the next late in August, when the lights were said to be put out by birds. Mr. Dwight read a highly-colored newspaper account of the killing of nearly 1;500 birds on the night of August 22–3, its statements exciting much

merriment. He said it was utterly untrue that birds were burned or roasted, except in the case of one or two birds which had fallen near the heat. The slaughter of birds on this occasion was due to the first cold wave of the year, which started the migration. Mr. Dwight also read newspaper accounts of the slaughter in 1888, one account stating that in a single night 500 birds were killed. The first date at which birds struck the statue in 1889 was Aug. 5, when 14 were killed. A few others were killed during the month, and a considerable number in September and October. Oct. 24 was the last date at which birds were killed. The whole number killed this year, was 690, which was considerably less than in 1888 or 1887. Mr. Dwight began visiting Bedlow's Island Sept. 19 this year and had studied the birds and recorded the species. He found that every cold wave in the early Fall was followed by migratory birds flying against the statue. Of the dead birds picked up this year 60 per cent. belonged to one species, the Maryland yellow throats. The remaining 40 per cent. included a great variety.

Discussion followed as to the effect of darkness in causing the destruction of birds, and as to whether sparrows and humming birds were ever among the migrants killed.



SAND DISTRIBUTOR FOR ELECTRIC CARS.

Automatic Sand Distributor for Electric Cars.

The reputation which the electric car has obtained for climbing heavy grades has made it a favorite on roads of this character. In wet weather, however, the slipping of the wheels on the track sometimes causes annoyance, and sanding has to be resorted to, not only in starting and in climbing the grades, but also in stopping the car and in holding it when descending a grade. To accomplish the distribution of the sand automatically, the Jordan-Mills Company, of this city, has recently designed the arrangement shown in the accompanying illustration. As will be seen, the pressure exerted by the motorneer's foot, exerted through the levers, opens the valves which distribute the sand on the tracks. By the arrangement adopted no cutting of the car is required, and the valves, being placed inside the car, are protected from the weather. By regulating the pressure on the treadle any desired quantity of sand can be allowed to escape from the valves.

We may add that these sand boxes are in use on a number of electric cars, among them being those of the Daft Company, the Julien Company and the Electric Car Company of America.

Serpollet's Instantaneous Steam Generator.

In many instances it is often desired to have the electric light at a distance from central stations, but the inconveniences which attach themselves to the running of private plants have often deterred the undertaking of them. To meet such cases, M. Serpollet has recently applied his instantaneous steam generator or boiler in conjunction with an engine and dynamo.

The principle of this boiler consists in the production of steam as fast as it is wanted, in a long, flat metal tube, having a space of hardly 1.6 millim. thickness between its walls.

In the late machines the tubes constituting the principal element of the boiler are of copper, laminated, forming a double spiral plate, and having a number of raised ribs, which facilitate the heating of the metal body. These ribs strengthen the arrangement and form a reservoir for the heat and increase the heating surface.

The boiler shown in the engraving, taken from *La Nature*, is the 1 h. p. type, its evaporation being 44 pounds of steam per hour; and in combination with it is shown a small electric light plant, consisting, in a very compact form, of the steam generator, engine and a small continuous current dynamo.

The engine is of the horizontal type, the diameter of the cylinder being about 2½ inches, the stroke 1¼ inch, and the speed 300 revolutions per minute.

With a pressure of 70 to 100 pounds, the engine produces 1 h. p., and consumes 33 pounds of steam per hour.

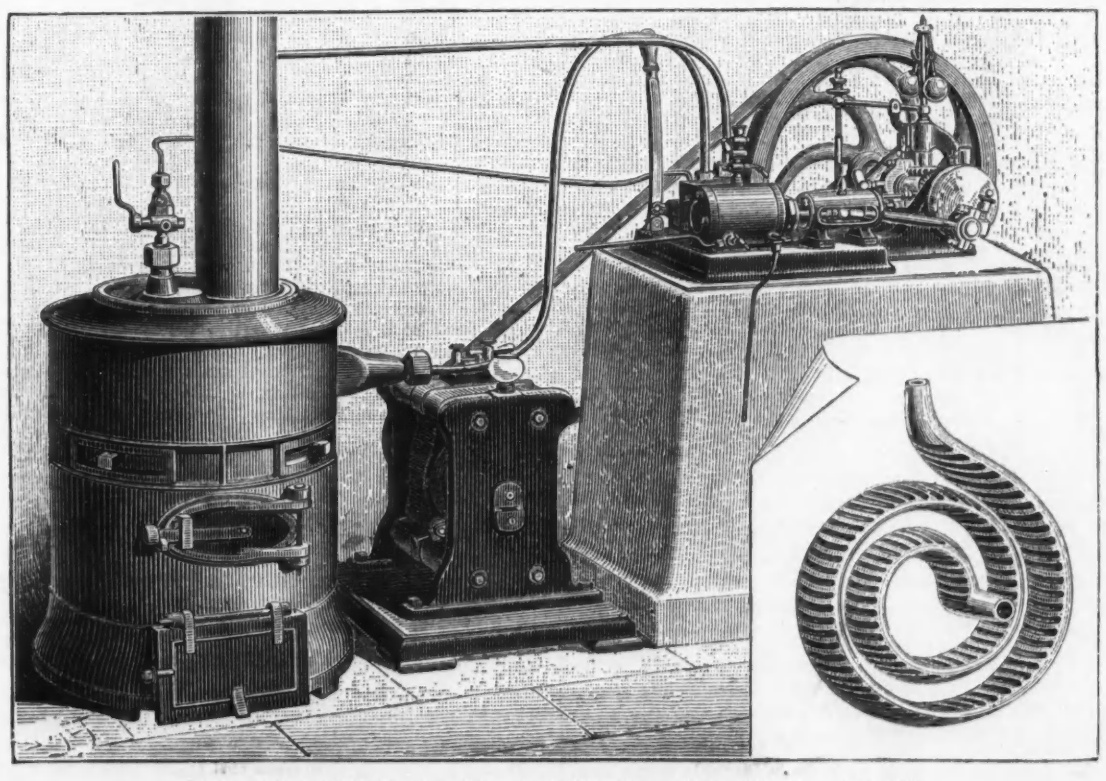
By means of a small centrifugal governor, which regulates the action of the feed pump, the speed of the engine is maintained constant under variation of load. The starting is effected by the injection of water into the boiler by means of a hand-pump, and the feed is then continued by the automatic pump. The stopping of the feed immediately stops the machine. The coal consumption is 10 pounds per hour for a 1 h. p. engine, such as the one shown, capable of running a small electric light plant of from 8 to 10 lights.

Progress of the West End Street Railway Company.

For the past few months gangs of men have been steadily converting the great system of horse-car roads in Boston into an electric railroad system which has no equal in the world. All over Boston, both in the heart of the city and out in the suburbs, the steel poles which support the span wires, which in turn support the trolley wires, have now become a familiar sight. These poles, some five thousand of them, have been furnished by the Walworth Manufacturing Company, of Boston, and are generally conceded to be entirely suitable to the work, and neat and graceful as well. Most of the poles which will be used this season are now in position, but large gangs of men are still busy stringing the trolley wires and feeders. The trolley wires are composed in some places of silicon-bronze wire, and at other places of hard-drawn copper wire, and the size used has been chiefly No. 0 B. & S. gauge. On Shawmut avenue, from Grove Hall to Tremont street, along the Common to Scollay Square, these wires are now in place, and this week that section of the road was opened to the public. The feeders, which are made of No. 0 and 0000 wire, have been largely supplied by the Simplex Company, but a large amount of P. & B. wire, furnished by Pettingell, Andrews & Co., will also be used. The span wire is of steel, and in the most recent construction a new form of insulator for suspending the trolley wire has been adopted. It is shaped like a half circle, with two projecting ends to which are fastened the span wire, and has an insulated collar, through which the bolt which suspends the trolley wire is inserted. This admits of the trolley wire being on the same level with the span wire, which is a great improvement over the old method, and is much more symmetrical in appearance. The temporary power house on Harrison avenue and Albany street will contain five 250 h. p. McIntosh & Seymour compound condensing engines, and fifteen 80-h. p. generators of the Thomson-Houston type. Three engines and six generators are now in position, and are working with marked success. Each engine drives three generators, which are each capable of developing 500 volts and about 150 ampéres. Four Babcock & Wilcox boilers furnish steam for this plant. The cars and motors are of the regular well-known Thomson-Houston type, and the motors are made as thoroughly waterproof as it is possible to make them in case of any splashing while in service. A new device for illuminating the tow cars as well as the motor cars is now being tried on the Cambridge division. This consists of a double pole coupler, which makes practicable a waterproof electric joint between the two cars, which can be connected and disconnected in a second by simply pushing together or pulling apart. Mr. L. F. Jordan, of Boston, is the inventor.

The site of the permanent power house is a busy scene, an army of men being at present engaged in driving piles for the foundations. When finished the power house will contain ten 1,000 h. p. compound engines of the Reynolds-Corliss type, and the generators will be made to develop 250 h. p., and are now being built at the factory of the Thomson-Houston Company at Lynn. The boilers will in all probability be of the Babcock & Wilcox type. The feeders will eventually be put underground, though no attempt will be made this year to do so. Bare wire. No. 00 B. & S. gauge, has been laid between the tracks all along the route, and this wire is jointed to every rail, the wire and its connections looking like a gigantic fish bone. The West End Street Railway Company have put up all the poles and feeders, and the Thomson-Houston Company have done the construction work of the trolley wires. Some 16 cars are now running on the Shawmut avenue line. The temporary switchboard will be complete in every detail, and is now furnished with an ammeter for each generator, voltmeter and field resistance coils, and each generator has also an automatic cut-out, as a safeguard, should any overload or short circuit take place on the line. The work has been vigorously pushed along in the interest of the West End Company by F. S. Pearson, ably seconded by Mr. L. S. Dumoulin, while Mr. Mansfield exercises control for the Thomson-Houston Company. This week Mr. Mansfield delivered a practical and valuable address on electricity as connected with the operation of street railways, at the Allston power house, to the superintendent of time tables, the division superintendents, the inspectors and the starters of the first and second divisions. Boston now bids fair to beat the world in its equipment of electric railways, and will shortly have a system which it is proud to show, and which will undoubtedly excite interest all over the civilized globe.

A. C. S.



THE SERPOLLET STEAM GENERATOR FOR SMALL PLANTS.

Discussing Overhead Wires at the Dinner of the Boston Electric Club.

The first dinner of the season was held on Tuesday evening, the 12th inst., at the Boston Tavern, at which the following gentlemen were present:

F. J. Boynton, M. W. Turner, John Post, Jr., T. T. Robinson, W. D. Warner, F. E. Pettingell, W. E. Decrow, Frank Ridlon, A. P. Wright, Mr. Steiners, C. B. Mitchell, Captain Wm. Brophy, H. H. Eustis, O. K. Stuart, A. C. Shaw, J. R. Magee, Thos. B. Doolittle, J. C. Wilson, A. Wyats, H. B. Cram, G. T. Manson, C. M. Ransom, Dr. Austen, C. W. Holtzer, W. J. Denver, O. P. Clark, J. F. Colber, J. R. Murphy, R. J. Fitch, B. S. Flanders, John Deimot, A. H. Chapman, W. A. Hovey, Mayor Hart, H. A. Chase, Dr. Debousser, Dr. A. Watts, Chas. W. Holden, Winthrop Thayer, J. R. Bullard, Richard Tobin.

The invited guests were His Honor Mayor Hart, Fire Commissioners Robert G. Fitch, J. R. Murphy, R. F. Tobin, and B. S. Flanders, superintendent of fire alarms; Henry A. Chase, police electrician, and W. E. Decrow, of the Gamewell Fire Alarm Telegraph Company.

The dinner was served at 7:30 P. M., Mr. W. J. Denver, president of the club, occupying the chair, and was thoroughly enjoyed by all, the house and entertainment committee having provided everything for the comfort of the members and their guests. After dinner an interesting discussion on the "Municipal Regulation and Control of Electric Wires and Wiring" took place, and much was said to induce Mayor Hart to refrain from falling into the grievous errors which Mayor Grant, of New York, has made.

Mr. Denver in opening the discussion alluded to the serious interest this question was eliciting from all engaged in electrical pursuits, and spoke of the willingness of electrical men to have some form of conducting their overhead construction so as to remove all possible danger. He then introduced, in his usual happy manner, the various speakers, the first on the list being Mayor Hart, whose remarks were listened to with deserved and marked interest.

Mayor Hart said he felt great interest in the question of the control of electric wires, and gladly availed himself of this opportunity to hear electric men discuss this question, so that when the proper time came he could intelligently (though metaphorically) "take hold of the electric men by the nose and put them right where they belonged." He was quite convinced that some form of control ought to exist, but up to the present he had formed no decided opinion as to the nature of that government. He was there to learn, and hoped the discussion would be thorough.

Mr. C. M. Ransom, in the course of his remarks, drew attention to the fact that the Boston Electric Club, and later the New England Electric Exchange, had been organized for a purpose, and that was that all wires in the city of Boston should be so disposed that they could be readily passed by the Board of Fire Underwriters. If there had never been a Board of Electrical Control in New York there never would have been any trouble with the wires. Several Boston papers were trying to get new legislation, but Mr. Ransom's plea was to leave the matter to the Electric Exchange, which was composed of some of the brightest minds in the country.

Mr. John C. Wilson remarked that it was entirely useless to deny that there was danger in some forms of electric wires and strongly advocated that there should be some board of electrical control, not composed of such men as the New York board boasted of, whose main object was to get the wires into the conduits of the Phœnix Construction Company. Electric light wires should be kept separate, and in the same way as there was a captain of a ship there should also be a captain of wires.

Mr. Ridlon then made an eloquent plea for the burial of the "dead" wires, and believed that by doing so one-fifth of the wires would disappear. Inspect the construction of all lines of wire, put up structures that will stand, and then the question of putting wires underground could be considered. Mr. Ridlon believed that there were more people killed in Boston by cold water than by electricity. Mr. Ridlon then warned all to beware of putting politicians in control instead of electricians, and pointed to the New York board as an example.

Mr. H. B. Cram advocated strongly some method of control, and considered that a proper law could be passed, which would interfere in no way with the interests of the different electric companies. Mr. Cram stated that on careful investigation, deaths by electricity were found to be very much under the number of deaths by other causes, which were necessities of civilization in large cities. He drew attention to the fact that the great difficulty with underground wires was in making the necessary connections to the overhead lines. The control of wires should be vested in the hands of men who thoroughly understood their business, not legislators. Mr. Cram then went on to explain how the New England Electric Exchange was a step in the right direction, which now made every man who was engaged in the wiring business pass examinations before they were allowed to undertake responsible work.

Captain Wm. Brophy stated that he was thoroughly convinced of the vital importance of the question at issue, and drew attention to the daily enormous increase in wires in a large city. Where was it going to end? The underwriters had early come to recognize that the subject of wiring was a new branch of their business. Inside buildings they had the right to exercise control over the wires, but on the street it was entirely different. He believed that the Underwriters' control should be supplemented by municipal control of all overhead wires. No low-tension wire should be placed on the same pole with high-tension wires. He was convinced of the impossibility at present of insulating wires underground, and believed that the accidents in New York were distinctly traceable to the inefficiency of the people in authority. There were more lights in Boston than in New York and much better construction. Capt. Brophy wound up by expressing a hope that a man would be appointed in authority, who was not popular, but who was honest in his intentions and thoroughly skilled in his business.

Mr. A. H. Chapman also made an eloquent appeal for the control of electric wires, and suggested that three electricians be appointed by the Mayor or the Governor, who should have complete control of the wires and the construction of overhead work, and to whom all questions of rights should be referred, as he was of the opinion that legal questions were sure to arise. The interests of the general public demanded such a commission to look after their interests and convenience.

Mr. Robert G. Fitch then made a few appropriate remarks, and in conclusion

Mr. W. A. Hovey pleaded strongly to keep the matter out of the hands of the Legislature. He instanced several cases of the incompetency of legislators to understand such a question, and asked if electric men would allow them to frame laws for subjects of which they knew nothing. There was far too much law now, and he warned them not to hasten to have more legislation, which would in all probability be wrong. He stated that experience teaches that legislation in such matters is always wrong. He believed the accidents in New York were caused mainly by bad construction, and latterly by the action of the Mayor, who positively forbade all attempts at repairs. In conclusion, he said: "Don't feel that the law is a panacea for all ills."

About 11.30 P. M. the party separated, and all agreed that a most enjoyable and interesting evening had been spent. The Mayor has now a great many valuable opinions to consider ere he takes any decisive step in the matter of placing the wires of Boston under municipal control. The result is looked forward to with much interest by all.

A. C. S.

A Presentation to Mr. Abdank-Abakanowicz.

On Oct. 24 last the electrical exhibitors in the United States section at the Paris Exposition invited Mr. Abdank-Abakanowicz to a dinner at the celebrated Café Durand, known to all good Americans as the cafe *par excellence* for *la haute cuisine* and the most exquisite wines to be had in Paris. The menus were beautifully got up in white and gold, with the names of the subscribers on one half of the cover, and the Abdank-Abakanowicz monograph and arms in relief, also in gold, on the other.

The table groaned beneath the most beautiful exotics and argenterie, while the famous Sèvres dinner service, once the property of a crowned head, and which is only brought out on special occasions, was used. Covers were laid for fourteen guest, among whom were invited General Martini, of the French Army; Gen. W. B. Franklin, of the United States Army; Mr. E. de Souberbeille; Mr. Boye, of the French Press; Mr. Haynie, correspondent of the Boston *Herald*, and Mr. Carl Hering. Letters of regret at absence were read from several other notables.

Mr. J. Draper Bishop presided, and he was most ably supported by Mr. Meech, as vice-chairman, while Mr. E. Thurnauer, as chairman of the steward's committee, was responsible for the table arrangements.

The president first called on the guests to drink to the health of the Presidents of the two greatest Republics, France and America, which was enthusiastically responded to. In proposing the health of Mr. Abdank, Mr. Bishop referred in brief but pointed terms to the able and enthusiastic manner in which Mr. Abdank had served the best interests of the United States, and the energy he had displayed in securing to the American exhibitors the awards they had received. Out of thirteen grand prix, four had been awarded to America. In the course of his speech, which was eloquent and to the point, Mr. Bishop said that he had been asked why invitations had not been issued to the officials of the United States Commission and the United States Legation. He said that this was by no means an oversight on the part of the committee. On the contrary, while admitting that the presence of United States officials would undoubtedly have added lustre to their efforts to honor Mr. Abdank-Abakanowicz, still it was decided that nothing should be done which might be considered as infringing on the prerogative, or which might diminish the prestige of any steps which the United States government might deem fit to take to signify their high appreciation of the services Mr. Abdank had rendered to the United States world of science, as represented at the Paris Exposition. He further remarked that it was the wish of the subscribers to this testimonial that it should rather be one of cordiality and good fellowship, and as a mark of personal esteem, than one of recognition of his official courtesy and tact, and that was another reason why the high representatives of France and America had been invited that evening personally and not officially.

He then read congratulatory telegrams from absent subscribers in America who had joined with those present to do honor to their friend and guest, whom they all esteemed as a man of fact rather than of eloquence. And as facts speak louder than words he would refrain from complimentary speeches and effusive praise, and ask Mr. Abdank to put his own interpretation on their presence and their request that he would accept the testimonial which the vice-president would now hand him, assuring Mr. Abdank that if he kept that testimonial until the donors forgot him he would live to a good old age. He concluded by thanking him in the names of those present, in the names of the companies they represented, and in the name of all Americans interested in electrical science, for the honest and manly and courteous cordiality which had characterized all his relations with those on whose behalf he was offered this testimonial.

The testimonial consisted of a very handsome silver coffee set, Louis Quinze style, with gold monograms, and a morocco case on whose lid was engraved on a silver plate "Souvenir. Paris Exposition. To Prof. Abdank-Abakanowicz, from his electrical friends in the Industrial Section of the United States."

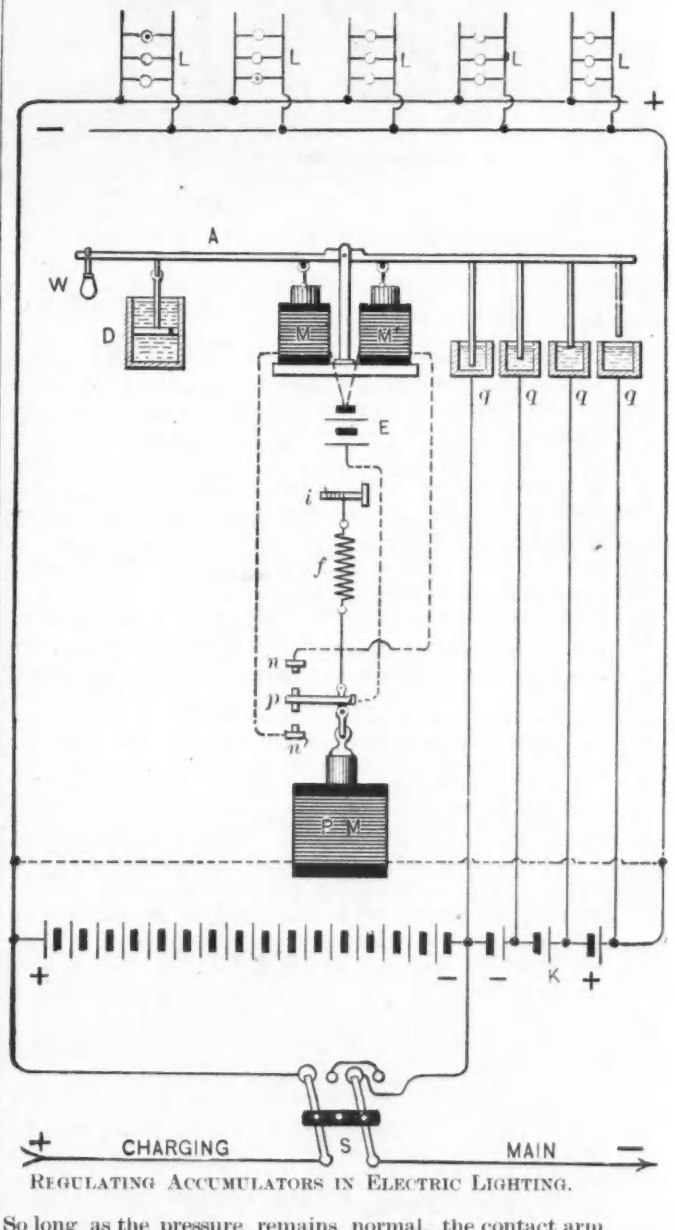
Mr. Abdank's reply was brief, but full of emotion. He said that he was one of those men who never did anything he did not find a pleasure in putting his energies into, and if he had shown any virtues to merit such a reception and so handsome a testimonial, it was because he had to do with gentlemen whose acceptance of his endeavors and the cordial help he had received from them made his duties of the lightest and most agreeable. He closed by saying that in drinking back to them all health, long life and happiness, his heart went with his words.

So much good feeling was evoked that it was with much regret that the guests dispersed. The service was manufactured by Baudot, of the Boulevard des Capucines, and is a beautiful specimen of French art. The following is a list of the contributors to the testimonial: American Bell Telephone Company, Boston; Commercial Cable Company, New York; Consolidated Subway Company, New York; T. A. Edison, Menlo Park; Electric Club, New York; Elektron Manufacturing Company, New York; Gardner Time System Company, New York; Elisha Gray, Chicago; Heisler Electric Light Company, St. Louis; Okonite Manufacturing Company, New York; Sprague Electric Motor Company, New York; Thomson-Houston International Electric Company, New York; Thomson International Electric Welding Company, Boston; Western Electric Company, Chicago.

Regulating Accumulators in Electric Lighting.

In the discussion which followed the reading of Mr. Geo. B. Prescott, Jr.'s, paper on the above subject before the American Institute of Electrical Engineers, the author referred to another method not included in the paper, which we give below:

In the diagram the lamp circuits L are shown at the top, leading from the mains (+) and (—). Connected across the lamp mains, preferably at a point of average potential, is the solenoid magnet $P\,M$, which is wound with fine wire. The position of the plunger or armature of this magnet is so adjusted by means of the retractile spring f, that when the pressure is normal the contact lever p, carried by the plunger, is midway between the local contact points $n\,n^1$. Probabably most of my hearers are familiar with the Kohlrausch voltmeter, which is constructed on this principle of the solenoid magnet, and are aware that while it is not an entirely reliable instrument on account of variable friction and hysteresis, it still has a wide range and is very sensitive when the plunger occupies a given position. Now this magnet, $P\,M$, depends on this fact, and only needs to be accurate for one position of its core. If, for example, the magnet is wound for 100 volts, then, when it is connected with two points in the lamp circuit, having a difference of potential of 100 volts, the core will occupy a certain position. If the pressure exceeds 100 volts, the core will be drawn into the magnet. If the pressure falls below 100 volts, the core will be withdrawn by the retractile spring. This core of the pressure magnet is suspended from the adjustable shaft i on the spring f, and carries the local contact arm p on its upper end. When the core is drawn into the magnet this is brought into contact with the screw n^1, and when it is drawn out by the spring, contact is made with the screw n.



Regulating Accumulators in Electric Lighting.

So long as the pressure remains normal, the contact arm remains midway between the screws $n\,n^1$, for which position the primary adjustment must be made. If now the pressure becomes either excessive or falls below normal the circuit of the local battery E will be closed respectively through one or the other of the local solenoid magnets $M\,M'$. The cores of these local magnets are attached to a balanced lever A at equal distances from and on opposite sides of its point of suspension, and the whole constitutes a simple modification of the regulator shown in Figs. 14 and 15 of the paper.* The necessary weight of the lever on the side carrying the contact rods which dip into the mercury cups $q\,q$, etc., is compensated for by extending the lever for an equal distance on the opposite side of its fulcrum, and by adding a suitable counter weight W.

The operation of this apparatus requires that the lever should remain quiescent in whatever position it may be drawn by the action of either magnet M or magnet M'; and that, moreover, any movement of the lever at all, tending to make or break contact with the mercury cups, should be very gradual. Both of these results are accomplished by introducing a slight friction at the point of suspension of the lever and by adding a carefully adjusted dash-pot D in the manner shown in the sketch. Thus while the slight friction alluded to causes the lever to remain at whatever angle it may be placed, the dash-pot prevents the lever from moving except very slowly to whatever position the action of either magnet may tend to set it.

The function for which this regulator is employed is precisely the same as that performed by the somewhat similar regulator shown in Figs. 14 and 15, viz., to insert in, and

* See E. W. of Nov. 9.

withdraw from, the main lamp circuit more or less counter-electromotive force cells K, according as the pressure at the lamp terminals exceeds or falls short of the normal. The regulator acts in the following manner: Assuming the potential to be normal, the local contact lever p will stand midway between the contact points $n\,n^1$, and the regulator lever A will be horizontal as shown in the diagram. Now if the potential at the lamps increases, the core of the pressure magnet $P\,M$ will be drawn down until it closes the local circuit through n^1 and magnet M, and this latter magnet will slowly tilt the lever p toward its side, and thus cause first one and then another of the counter-electromotive force cells to be inserted in the lamp main, thereby reducing its potential. When a sufficient number of cells have been inserted in the lamp circuit in this manner, to reduce the pressure again to normal, the core of the pressure magnet again resumes its normal position, breaking the local contact at n^1, while the lever p continues to remain in its new position. If, from any cause, the pressure at the lamps now falls below normal, the attractive power of the solenoid $P\,M$ will become correspondingly reduced, and the retractile spring f will draw up the core until the contact lever p closes, through the point n, the local battery circuit through the the magnet M^1. This causes the lever to be gradually tilted in the opposite direction from before, and therefore to cut out of circuit one or more counter-electromotive force cells until the normal pressure at the lamps is again restored.

It will be seen that this regulator thus automatically maintains a constant pressure at the lamp terminals, irrespective of the fact whether variations of this pressure are caused by the charging current, or by the resistance of the leads when the lamp load is altered.

Belt Tension.

BY ROBERT GRIMSHAW, PH. D.

This is not going to be an article full of algebra, or even of figures. I have gone all through the algebra and the figures, both from pure theory and from actual practice, and am going to treat the subject as though what I want to say has been proved beyond the shadow of doubt.

A driving belt carries power because of the friction between it and the pulley which drives it, and of that which it drives. To a certain extent it may be said to work just like a chain working between two sprocket wheels. Projections and depressions in the sprocket wheels engage in depressions and projections in the chain, and so one wheel drives the other through the chain. In the same way, projections and depressions in the so-called smooth pulley face engage depressions and projections in the belt, and thus one wheel drives the other. In the case of the sprocket wheel and chain, it takes considerable more resistance to the motion of the driven wheel to cause the chain to override the teeth of the wheel; and more damage is done to chain and wheel in such case than to belt and pulley. But in each case there is damage done. Any slip of a belt over and above two per cent. causes damage to the belt and lessens the permanent driving power of the pulley by making it too smooth.

Friction being more the result of an interlocking of particles, it is hard to say that a belt should be "smooth," and that a pulley should be "smooth," for this is a relative term. What would be smooth for a grindstone would be very rough for a driving pulley. What would be a very rough pulley for driving one kind of belt would be a very smooth one with another belt. The condition of each surface must be judged only in connection with that of the other one which is to rub with it. There are cases where greasing a belt makes it drive better, and there are others (the most numerous class) when any kind of oil other than a special belt grease, makes the driving less efficient.

That degree of oiliness is required of a leather belt which will make the belt pliable and flexible enough to bed down well to the pulley face, without making it slip when it gets there. Any one who has had much to do with belts will recognize this as a fact; yet how many who have run belts know that the same principle is applicable to the question of belt tension; that that extra pressure which, to a certain extent, will bring the belt better down to the pulley face and cause an increase of friction, will, if carried beyond a certain point, so flatten down the face of the belt as to render it more slippery than when there was less tension. I reasoned this out for myself several years ago, and tested it with a great many kinds of belts upon all sorts of pulleys, and under every condition that I could get up to try the matter on, proved that the theory was correct.

So now we may assign the injury done by every tension to two separate causes: (1) The increase of journal friction caused by the belt hauling so hard on the pulleys; and (2) Decrease in the gripping value of the belt itself—a decrease which often continues after the excessive tension has been removed

In fact this second named cause may exist without the first, as in the cases (they are few, but that is because millwrights, and other mechanics do not keep their eyes open) where the pull of one belt is made to neutralize that of another which is hauling on the same shaft. In such cases, these shafts which have two belts pulling on them in different directions, do not have any increased wear by reason of the increased tension.

Experiments made by me with pulleys from 4 to 12 inches diameter showed that the drive increased with the tension from that point at which the belt was too slack to drive at all, to a certain maximum point, which varied with the material of the pulley, that of the belt, and other conditions, and then it fell off; the loss in driving power being entirely distinct from that by excessive friction. It must be remembered that when there is a loss of net driving power by reason of a belt hauling too tightly upon the journal and bearings, the engine pays that loss; where it is only a case of slip there is no power wasted, only capacity lessened. This latter case is like that of running an engine with one head off, and the ports blocked at the open end; there is just one-half the power generated; but then there is just one-half the steam required. There is generally a decreased "duty" at the same time with the lessened capacity and steam consumption; but the fact remains that these three things, capacity, duty and fuel consumption, are independent of each other.

But in any case it is desirable to have the belts run as slack as they can be run; and they can be run slacker by having the tight or driving side on the bottom, if the pulleys are on horizontal shafts in the same, or nearly the same, horizontal plane.

Another question that comes in with considerable importance is the increased life of belts and lacings where the belts are run slack. Still another way in which increase of tension may lessen the capacity of a belt is by stretching it in length and making it correspondingly narrower and thinner. If the belt is made narrower by the tremendous haul upon it, there is less contacting surface; and we are making a 7-inch belt do the work of an 8-inch by putting upon it an amount of tension sufficient to stretch it in length and put excessive pressure upon journals and bearings.

This excess of length, if on the lower side, lessens the arc of contact; and this, of course, lessens the driving power of the belt, no matter what the other conditions. And so we see on every hand every indication points to the necessity of running belts as slack as steady drive will permit.

The Electrical Exhibits at the American Institute Fair.

The number of electrical exhibits at the American Institute Fair increases from year to year, and this year's exhibit in this department is no exception to the rule of progress. THE ELECTRICAL WORLD has already mentioned several of the exhibits in these columns.

One of the best displays is the handsome exhibit of the Continental Dynamo Company, of this city, who have a finely finished 150-light dynamo running from the main shaft and driven by one of Schieren's "Electric" belts at a speed of 1,050 revolutions per minute. The machine furnishes current for 81 lamps at 16 c. p. distributed in various parts of the exhibition, and also for 21 motors of all sizes. The exhibition space is covered by a wooden canopy prettily got up and fitted on the inside with 50 16 c. p. lamps. At one side is the switchboard and resistance box, and raised upon a platform is a C. & C. motor driving a fan.

Another dynamo exhibit is that of the Wenstrom Northern Electric Company, of this city, in charge of Mr. Blum, the treasurer of the company. The dynamo shown is of the latest improved type, and generates current for 100 16 c. p. lamps. They also show a new two h. p. motor. The illumination of 100 16 c. p. lamps can be seen all over the fair.

The Elektron Manufacturing Company, of Brooklyn, manufacturers of the Perret motors and dynamos, have one of their small dynamos running in the exhibit of the National Meter Company, where it is driven by a Nash gas engine. The current feeds 24 16 c. p. lamps, illuminating the display very effectually. The gas engine is of their improved type and runs very steadily.

The New Century Electric Company's exhibit is in charge of Mr. M. Mayer, a protégé of one of our most prominent electricians. The dynamo exhibited has already been illustrated in the WORLD, and attracts considerable attention, as does also one of the ½ h. p. motors and the improved electro-plating machine built by the company. The motor is shown running one of the plating machines, which gives a current of 50 ampères at 4 volts.

A good application of the electric motor is that of the Excelsior Electric Company, one of whose 5 h. p. incandescent machines runs the Frisbie elevator at the exhibition through the medium of Schieren's link belt. The machine runs at a constant speed whether fully loaded or running free, and is perfectly noiseless in its operation. The elevator plant of the D. Frisbie Company is also interesting; the hoisting machinery being operated with the Frisbie friction-clutch pulley, automatic shifting pulleys and gearing.

Electro-medical apparatus is very well represented in the exhibit of the Jerome Kidder Manufacturing Company, of this city, who show a very complete line of galvanic and faradic instruments. Among other novelties may be seen their latest improved physician's cabinet supplied with a full set of batteries and a 40-point selector, by which any number of cells can be placed in the circuit. It also contains a galvanic and faradic combination coil and a slow and fast interrupter, together with resistance coils and a milliampèremeter for measuring the strength of the current. Besides this very complete arrangement, they show every variety of physicians', family and pocket batteries and various cautery and surgical instruments. This firm has received the highest awards in its class every year since 1872 and will no doubt be granted a medal this year.

The Continental Motor and Electrical Supply Company, of Newark, N. J., have a very good exhibit of regulators and governors for electric motors.

The Mather Electric Company, who have lighted the exhibition for several years past, are this year again furnishing current for six hundred and fifteen 16 c. p. lamps distributed throughout the building. There are two 400-light machines in operation, but the electrician in charge states that on more than one occasion the full number of lights was operated from a single machine. The plant was installed by the Tucker Electrical Construction Company, of this city.

Among the arc light exhibits is that of the Schuyler Electric Light Company, of Middletown, Conn., who have a very fine installation and light the fair with one hundred 2,000 c. p. arc lamps. The current is furnished by three dynamos with a capacity of 35 lamps each. Two "electric" belts of Schieren & Co.'s make drive the dynamos. Mr. N. G. Galloway is in charge of the exhibit.

The Hall Electric Pump Company, of Plainfield, N. J., exhibit their combination pump and electric motor. The exhibit is in charge of Mr. J. P. Palmer.

The Vassar Alarm Bolt Company, of this city, exhibit their manufacture in the shape of bolts with a special contact, which, when the bolts are tampered with, with burglarious intent, sets the burglar alarm in operation. As an addition to the other safety devices, this one is certainly worthy of attention.

A very pretty electric fan outfit is exhibited by Mr. Philip Diehl, of Elizabeth, N. J., together with a ½ h. p. motor. The very pretty combination of electric motor and sewing machine in which the motor is placed inside the fly wheel is also shown in operation and excites much admiration.

Among the displays closely allied to electrical work exhibited at the fair are various engines. Among these we find the Payne engine, built by B. W. Payne & Sons, of this city, who show one of their tandem 200 h. p. automatic electric light engines.

The Otto gas engines are exhibited in all sizes from 1 h. p. up to 20. Mr. N. B. Adams is in charge of the exhibit which is made by A. C. Manning & Co. of this city.

Messrs. E. E. Garvin & Co. have a very fine display of their machine tools for electrical work, including lathes, planers, spindle drills, screw cutting and universal milling machine. The machinery exhibit of Messrs. E. Gould & Eberhardt, of Newark, N. J., consisting of automatic gear cutters, drill presses, planing and milling machines, attracts considerable attention. The exhibit of Mr. John S. Hall of this city includes everything necessary for the lubrication of dynamos, and contains his various styles of oil and grease cups with automatic adjustable sight feed. These oil and grease cups are very finely finished. Mr. Hall also exhibits his waste-oil filter for economizing in the consumption of oil. As we have already noted above, the belts manufactured by Messrs. Chas. A. Schieren & Co., of this city, drive a number of the dynamos in the exhibition, and a large number of the other exhibits of moving machinery at the exhibition are operated with their belts. They also have an exhibit of their own in which they show belts in all sizes, "Electric," perforated, etc. The American Leather Link Belt Company, of this city, also have on exhibition their belts, together with machinery in operation to demonstrate the method of manufacture.

Messrs. Robertson & Hoople also exhibit belts, one of which drives the Elektron dynamo in the Nash gas-engine exhibit.

The Chalmers-Spence Company, of this city, exhibit their well-known asbestos covering for boilers, steam pipes, etc., in sectional coverings, sheets and rolls.

The Rhode Island braiding machine is also at work in this exhibit, making asbestos steam packing. Inquiry elicited the fact that the machine had also been employed in covering wire with asbestos so as to render it fire-proof, as well as insulating. W. T. H.

Meeting of the New York Electrical Society.

The second meeting of this society for the season was held on Wednesday evening, Nov. 13, in Prof. Chandler's lecture room at Columbia College. The subject was "How to Test Electric Motors," by F. B. Crocker, who occupies the chair of electrical engineering, recently established at Columbia.

Mr. Crocker treated the subject very broadly and began by giving the points to be considered in regard to the electrical efficiency of the motor as a prime mover, and he also entered upon the other tests to which a motor ought to be subjected. Thus, to begin with, he drew attention to the points to be considered in the workmanship, design, etc., of such machines, and showed in what manner the early machines were defective in this respect, and laid particular stress upon the necessity of bringing the centre of gravity of the machines as low as possible.

As another point in the construction of the machine, Mr. Crocker showed how tests ought to be applied, first, to obtain the resistances of the field and armature circuits, and also the insulating resistance of the motor, such as between the windings and the cores and base plate of the machine. With the aid of the new Weston voltmeter ammeter, Mr. Crocker showed how quickly a test of these resistances could be made Thus by passing a 10-ampére current through the machine, which was maintained at rest, he obtained the fall of potential at the terminals of the various circuits by means of a voltmeter, and, by the employment of Ohm's well-known formula, obtained the resistance directly without the use of the Wheatstone bridge, and, as he put it, in less time than it takes to place the bridge in position for work.

Passing next to the efficiency tests of motors, the lecturer pointed out different ways in which these tests could be effected. These he demonstrated by means of apparatus placed upon the table, consisting of a small Crocker & Wheeler motor, to which a brake was attached, the lever arm being suspended from the spring balance. Knowing the speed at which the motor runs, the length of the lever arm and the weight at the end of it, as registered by the scale, we have thus a ready method of obtaining the power of the machine; and, measuring the current by means of the ampèremeter, and the voltage by the voltmeter, the ratio between the electrical energy supplied and the mechanical power, as developed at the brake, gives the efficiency. Mr. Crocker pointed out, however, that the Prony brake tests do not always give the most reliable results, on account of the great difficulty of maintaining a constant speed on the machine, and he laid stress upon the superiority in this respect of the manner of obtaining the static pull with the motor stationary and with the normal current passing through the machine. The lecturer next proceeded to illustrate the more accurate method of testing motors devised by Dr. John Hopkinson. Mounted upon the platform was a 1½ h. p. Sprague motor belted to a small model Edison dynamo, the current of which fed a number of lamps. By measuring the electrical energy put into the motor and that given out by the dynamo, the ratio of conversion from electrical to mechanical energy is obtained; and, knowing the efficiency of one of the machines, the efficiency of the other is easily deduced.

The lecture throughout was replete with valuable hints and information on this subject and was listened to attentively by a large and appreciative gathering. The lectures of the New York Electrical Society will be continued through the season, and a number have already been arranged for, dealing with the most important electrical applications.

Electric Lighting and the Smoke Problem.

Mr. Henry E. Allen, of Chicago, makes the following suggestions for solving the smoke problem:

"I desire to offer a suggestion or two on the plans proposed. It has been stated by some competent authorities that the experience of several European cities is adverse to the high-water pressure system (as well as steam pipes): that the pipes are continually bursting, thus becoming a source of great danger and annoyance in the streets; that all electric conductors near them are liable to be so affected as to be worthless, to say nothing of the enormous cost of the system. The fuel-gas system is not open to any such serious objections, to my knowledge.

"If the city would adopt an electric power system in place of the high water pressure system, I believe it would be much more feasible, for the following reasons: The cost would not be more than half as great; the time of putting the plant in operation would be lessened by many months; the annoyance from tearing up the streets would be far less; the power afforded would be evener, with no danger of loss from pipes bursting in buildings, and connections

made with far less cost to users of power; power stations could be more advantageously distributed over the district covered, without reference to water supply; the plant could be utilized for street and residence lighting, as but little power would be required at night.

"I am aware that this plan affords no improved facilities for defense against fire or for washing the streets. But with a fuel-gas plant in operation and 2,000 stationary engines supplanted, fires would not be so frequent and the present water supply would not be so heavily taxed.

"The high water pressure system would have been well enough three years ago, but present day science has discovered something better, and as a means for the transmission of power electricity now stands without a rival.

"All that has been said in regard to the triple expansion engines and smoke-consumers for the power stations applies with equal force to one system as well as the other. There is no reason why the city could not control an electric power plant as well as an electric light plant, and a demonstration has already been given in this particular in favor of the latter.

"I know of no instance in which an electric power plant has been installed by a reputable company that has not proven highly successful and profitable. With a first-class fuel-gas and electric power plant in operation, under control of the city, the smoke nuisance would at once disappear, and both plants could be installed completely in fifteen months."

What Mr. Allen says about "defense against fire," etc., is fully covered by Mr. Alexander Kempt's plan of placing electric motors at street corners to increase the water pressure when necessary.

Ann Arbor Electrical Notes.

The new course in electrical engineering at Ann Arbor opens with thirty-one students, a few of them transfers from other courses, but most of them new men.

Nearly thirty students are now taking practical laboratory work in electrical measurements, in connection with lectures on units and methods, twice a week.

A large number of primary batteries of various kinds, collected from many manufacturers, are now in process of systematic examination for E. M. F., internal resistance, polarization and recovery curves, and duration. New apparatus has been added from Elliott Bros., of London, Queen & Co., and Wm. Marshall, and a cast-iron Brackett cradle dynamometer, capable of carrying a 100-light incandescent dynamo, is in course of construction in the mechanical department.

It is proposed to extend the electric lighting from the Physical Laboratory to the President's house.

On Electric Shocks.

BY P. H. VANDER WEYDE, M. D.

It is a very common error to consider the shocks received by coming in contact with the two terminals of an arc lamp, in series with other lamps, as equal to the whole electromotive force of the dynamo. This error was committed in the communication made Aug. 31, page 117 of volume XII., and it proceeds from not considering that the resistance of the other lamps in a long circuit and that of the line itself absorb most of the electromotive force. The case referred to mentions a 2,200 volt dynamo, with 44 lamps in series; this gives scarcely 50 volts for each lamp, conside ing the resistance of the line itself, and this is what Mr. Phelps received. It would not injure any one were it not that the electromotive force of 50 volts had driven the large quantity of nine ampères through his body. There we encounter the other very common error, consisting in neglecting the consideration of the quantity of current in combination with the electromotive force. A pressure of 50 volts alone is utterly harmless, and considerably more is occasionally received by almost every experimenter with static electricity, in which the voltage of the sparks can be estimated by thousands, while there is not enough quantity of current to do any harm, because in static electricity the quantity is immeasurably small, running into fractions of milliampères.

In the case under discussion, the workman received $50 \times 9 = 450$ watts, which is quite sufficient to knock any one down when we consider that by the slipping of the wire and consequent break of the circuit, an extra current was induced, fortified by the coils in the circuits of all the other lamps. This extra current I have fully explained in the paper read before the National Electric Light Association on Aug. 31, 1888, which was reported in THE ELECTRICAL WORLD of that date, and to which I refer.

Mr. Gaillard is perfectly right in his formula given in the issue of Sept. 28, page 214, which reduces the current actually received to its true value; but he will have to add the effect of the extra current induced by the breaking of the circuit in order to account for the severity of the results experienced by the workman.

I doubt if he would succeed in his offer to break the record of shock-withstanding, when submitted to a shock of say 100,000 volts, if he were to withstand also the result of the extra current on the breaking of the circuits, as the induced current generated at that moment far surpasses in voltage the original; it might amount to millions of volts and be equivalent to a stroke of lightning minus the quantity, which in the case of lightning may perhaps amount to megampères.

So far, Mr. Gaillard does not mention the amount of current in ampères; but in the following paragraphs he says that "instead of talking of shocks of so many volts, people should talk of the flow of so many ampères;" and further, he says: "As an analogy, I would say that a now so-called high voltage shock may be compared to a mere shower of rain, while a strong ampère shock would be a dam-breaking flood."

I consider this analogy very defective: a shower of rain produces an indefinite quantity of water falling down gently, while voltage is merely analogous to hydraulic pressure, which is entirely independent of the quantity, which may be a mere thread of water oozing forcibly from a pinhole, under a pressure of 10, 100 or 1,000 feet head. The ampère without voltage is analogous to water in a lake with little or no tendency to make it move, but when once put in motion by gravity, or any other cause, water will manifest its efficacy, chiefly by its quantity, but there must be a power to drive it, and this, in electric parlance, is the voltage, also very properly called the electromotive force. It is the mysterious agent which causes all disponible quantities of electricity to travel where we want to lead them; as Volta was the first to teach the way to produce it, his name was properly adopted for the standard unit of measurement of this force.

That prominent electricians are sometimes guilty of carelessness is shown by some of the reports of the recent meeting of the British Association, when Mr. Preece, of London, who is at the head of the Government Postal Telegraph System, stated that he did not expect that the dispatching of criminals in the United States would be successful, because he had recently tried to kill a pig with an induction coil which gave sparks 20 inches long, and he failed to accomplish his purpose. Here, again, is the same oversight of ampères in connection with volts. An induction coil converts the whole electric capacity ampères and volts of the battery which excites it, into the electromotive force, voltage, so that the ampères practically disappear, hence the very long sparks and their almost harmless nature.

I tested this practically in 1862 by means of the induction coil of the Cooper Union, while I was a professor of physics there; this coil, originally made for sparks of 10 inches long, was by some modifications and precaution improved by me so as to give sparks 16 inches long. At that time we had no knowledge of electrical units, even the names of volts and ampères had not been invented; all we knew then was that electricity manifested itself by intensity or by quantity or by both. I found that the chief feature of the induction coil was deficiency of quantity and excess of intensity, with which I could not kill animals. Dr. Kidder, now deceased, well-known on account of the medical batteries which he manufactured, offered to submit himself to the strongest charge of a 16-inch spark of the induction coil, which I gave to him in the presence of a reporter of the *Tribune*. The next day there appeared in the *Tribune* a sensational article, under the head of "An Error in Science Exploded," in which it was set forth that the idea of people being killed by artificial electricity was erroneous; that it could not be done; in fact, that the reports published to that effect were exaggerated and all nonsense. In 1862 about the same thing was said, that Mr. Preece mentioned at the British Association meeting now in 1889. However, the difference was this: what the *Tribune* reporter said in 1862 was true, as then we had no dynamos, while now we have them, and they do kill people, as we all know to our regret.

This was illustrated a few weeks ago when I was at Scranton, Pa., and saw there a horse killed and the driver severely shocked by the horse stepping on a telephone wire which had fallen on the street, while overhead it was in contact with one of the bare wires which furnish the current to the electric street cars (Sprague system). An important fact in regard to this accident is that the currents there are furnished by an Edison dynamo claimed to be of such low tension as to be harmless. I had visited the plant a few days before, and saw there five dynamos, one for each of the five car lines, They were stated by the engineer to be each of 300 volts and 100 ampères. The claim of Mr. Brown that such currents are harmless is thus disproved by Edison's own low tension and direct current dynamos, verifying what I have always held, that both kinds of currents may be dangerous, and should be carefully guarded against.

The Subway Situation in New York.

The ninety days' notice given the Brush and United States Electric Light Companies by the Board of Electrical Control to remove their poles and wires from Fourteenth Street has expired, and at the next meeting of the board it will be in order for the Mayor to be requested to have the poles and wires carted away to the corporation yards. It is not at all likely, however, that the city will be called on to do this work. The Brush Company proposes, it states, to do the work of removal itself. A representative of the corporation has notified the Board of Electrical Control that Fourteenth street shall be cleared of poles and wires by Saturday of this week, and the board has been requested, on the strength of this pledge, not to issue a formal order for their removal. It is understood that the Mayor will not interfere with the company if it is found to be really engaged in taking down its poles and wires.

The electric light subways in Broadway are rapidly approaching completion, and as soon as a union is made between the section building from uptown and that advancing from downtown the accommodation for electric light wires in this thoroughfare will be ample, and the ninety days' notice to the companies to remove their overhead wires will be issued. This will be in a very few days at the furthest unless unusually unfavorable weather interferes with the progress of the work; and the chances therefore are very good that Broadway will be clear of poles and wires in a few months, even if the companies do not voluntarily shorten the period of their existence by waiving their legal right to the ninety days of delay. The companies are as anxious as the public to have the wires underground, provided it can be done successfully.

The Dinner of the Institution of Electrical Engineers.

Our London correspondent, under date of Nov. 6, writes:

On Monday night the first annual dinner of this institution took place. Over 200 members and guests were present, and the whole proceedings were a pronounced success. Sir William Thomson occupied the chair, and among those present were the Marquis of Salisbury, the president of the Royal Society, Sir Frederick Bramwell, Mr. Courtenay Boyle (of the Board of Trade), Sir David Salomons, Major Marindin (of the Board of Trade), Sir Douglas Galton, Dr. W. Anderson (Director-General of Ordnance Factories), Sir Frederick Abel, the Astronomer Royal, Prof. Hughes, Prof. Fleming, Prof. Perry, Mr. W. H. Preece and Major-General Webber. After the usual loyal toasts, the chairman proposed Her Majesty's Ministers, and in so doing claimed that Lord Salisbury was one of the great army of electricians, in the sense of being a scientific electrician and an electrical engineer. The Prime Minister then responded in a most felicitous and suggestive speech. When he looked round, he said, on so many learned and distinguished gentlemen, he felt rather in the position of a profane person who had got inside the Eleusinian mysteries. His only excuse was that the Foreign Office with which he was connected might be said to positively exist by virtutehee o f lectric telegraph. He had often thought that if history were more philosophically written instead of being divided according to the domination of particular dynasties, or the supremacy of particular races, it would be cut off into the compartments indicated by the influence of particular discoveries upon the destinies of mankind. He thought that the historian of the future when he looked back would recognize that the discovery of electricity had exercised a far greater influence upon the progress of mankind than even the discovery of the steam engine, which with all its blessings had brought an unwholesome aggregation of men into large manufacturing towns. He did not despair that the possibility of transmitting power to a distance by electricity would have the effect of scattering these unwholesome aggregations. Men and women would then be able to pursue in their own homes many of the industries which now are carried on in huge factories. If ever that result should come about, electricians might say that they had not only added to the physical forces at the disposal of man, but that they had done much to improve the moral and mental condition of the race. After a few words from Sir George Stokes, President of the Royal Society, the Marquis of Salisbury again rose, this time to propose the toast of the Institution of Electrical Engineers, which he said was at a very interesting period of its existence. He concluded by drinking to the prosperity of the Institution, coupling with it the name of Sir William Thomson. Sir William Thomson, in responding, referred in well-chosen terms to the work done by the late Dr. Joule, who he said was not a mere visionary who saw, admired, cast a halo round and then left his work, but pursued what he saw to the very utmost practical point. He concluded by thanking all present most warmly for having chosen him to be the first president of the Institution, and for the way in which they had received his name.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Nov. 16, 1889.

Mr. J. P. McQuade, of the National Conduit Company, has completed the installation of 35,000 feet of cement lined iron piping in Chicago and a like amount in Milwaukee, for underground wire purposes. The quantity down in this city is 600,000 feet, and more is going in every week until Dec. 15.

Mr. J. B. Ecclesine, Jr., the New York representative of the Cobb Vulcanite Wire Company, has placed nearly 50 miles of the Cobb wires and cables in the New York conduits. Large quantities are also in use in Chicago, and he informs me that it has been adopted by a syndicate who will control all the conduits in Denver, Colo. A large order has recently been filled for cable over the drawbridge and river at Wilmington, Del., for electric light and power purposes.

The New Haven Clock Company, of 29 Murray street and 33 Warren street, have issued a splendid catalogue in their electrical department. It runs a length of 120 pages and is profusely illustrated, the descriptions also being very full. Electric clocks, gongs, factory alarms, watchmen's clocks, district messenger boxes and a great variety of other excellent apparatus are shown, and in every case the quality and cheapness of the apparatus is such as to command a large sale for the specialty.

The Complete Electric Construction Company, 14 Cortlandt S reet, contractors for all classes of wiri g, are busy as usual. They have lately completed work for 500 lights at the Fifth Avenue Hotel, for the Safety Electric Light Company; 200 lights for the German Masonic Temple, and 160 for the club house of the Seventh Regiment Veterans. During October they installed nearly 2,000 lights, including those in the Newark Public Library. They have also put in about 150 miles of single Safety electric insulated cables; also about 50,000 feet of telephone cable from the American Electrical Works, in the New York conduits.

Mr. George Woolcock is the superintendent for Messrs. Pierce & Francis, who are the manufacturers of the patent Thomas J. Woolcock's Son's nickel-plated and gold-bronze speaking-tube whistles. He showed me last week at the factory, 42 Cortlandt street, the interesting special machinery and processes employed in this class of work, as well as some very handsome pieces of it. His father was the inventor of such speaking-tube whistles in 1852, established the industry and brought out many improvements, which have since been supplemented. The above firm now turn out thousands of mouth-pieces, as well as tubing, etc.

Tool Cabinets.—I desire to call your readers' attention to a tool cabinet, made by the Miller's Fall Company, 93 Reade street. This cabinet is made in solid white ash and is handsomely finished. The standard size always in stock is $18 \times 34 \times 36$ inches. It is a work bench and tool chest combined, and is a valuable adjunct to an electric light station or telephone exchange. The top is of hard maple and furnished with an automatic steel bench stop and vise; it also has a detachable backboard with racks for tools, and below the top are six drawers for holding tools, nails and every kind of paraphernalia needed for general work. An illustrated des ription can be obtained from the company.

A. V. Meserole, 26 Church street, has been working in the storage battery field for a number of years. One type of battery he invented was adopted by the River & Rail Electric Light Company. It is claimed by the Meserole Electric Storage Battery Company that the type they are using of his does not interfere with any of the rights of their various competitors. It is composed of a lead support frame with open spaces horizontally with the plate for the introduction of very thin strips of lead or other quickly oxidizing metal, which is supported over the face of the support frame by strips of lead and treated chemically in the usual manner. Mr. Meserole claims that this form of battery, containing two negatives and one positive plate can be quickly rendered active. A small cell shown me gives 20 ampère hours at 2 volts, and can be discharged at the rate of 10 ampères.

Brooklyn, N. Y.—On Nov. 13 Saengerbund Hall was gay with lights and music and merry couples, the occasion being the third annual ball of the Citizens' Illuminating Company's Employés' Mutual Benefit Association. The attendance was very large. Dancing was begun at 10 o'clock and lasted until the "wee sma' hours" of the morning. The grand march was participated in by seventy-three couples. It was led by Mr. and Mrs. Benjamin F. Rush. The ball was a most enjoyable one in every way, and the members of the association have just cause for congratulation on the success that attended it. The association was organized three years ago, and is in a very prosperous condition. It has seventy-one members. The officers are: W. H. Browne, president; Paul Whitehead, vice-president; E. Reynolds, secretary; J. R. Barefield, treasurer; P. Creighton, sergeant-at-arms. The ball was in charge of the following committees: Reception—E. F. Peck, J. Supple, J. Duncan, H. Bell, M. Brennan, M. Smith, G. Harris. Floor—B. F. Rush, J. Carboy, G. Morris, W. H. Kuehn, M. G,

Fullam, E. Duncan, R. Yates, C. Chute, H. Brown, W. Duryea. Arrangements—T. Duffy, G. B. Hughes. F. P. De Forrest.

Mrs. Truax's "Electric Vehicle."—I was much amused this week on calling upon Mr. W. P. Freeman, of the Freeman Electric Manufacturing Company, 33 Gold street, where he first introduced me to Mrs. Truax, and then to Mrs. Truax's electric vehicle, which is composed of a peculiar tin-bottomed boat about sixteen feet long and suspended from the axles of four bicycle wheels. The axles were run through slots in the side near the top of the boat. The forward axle is bolted in the centre so that the wheels can be swerved to suit any direction by the action of special steering gear, working upon the axle under the driver's control. The rear axle is bolted solidly to both edges of the boat, in the centre of which axle is a large cog wheel about fifteen inches in diameter. Solidly bolted to either side of the boat are two strong boards to hold Mrs. Truax's peculiar electric motor, composed of four magnets of three spools each set opposite each other about three inches apart and laid flat. In the centre of the four magnets is a rocking armature of plain steel, so that two pairs of magnets can draw alternate ends and *vice versa*. On the ends of the steel armature are arms, as in the piston rod of an engine, or revolving a shaft at one end which carried a small gear wheel, which, in turn, engages the large gear wheel on the axle of the rear wheels for propelling the vehicle over land or in water. Paddles are to be constructed in the web of the rear wheels to propel it in water; the power is to be furnished by storage batteries of Mr. Freeman's construction, which he says are of the dry powder order. Mrs. Truax says that Mr. Freeman made a similar vehicle for her a couple of years ago, which worked very successfully. Mrs. Truax is herself supervising the work. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Nov. 16, 1889.

An Okonite Cable has just been laid across the harbor by the Okonite Company, of New York, for the New England Telephone Company.

Belfast, Me.—The Belfast Electric Company has ordered a 100 h. p. Corliss engine for additional power, which will be erected within a few weeks.

Westinghouse, Church, Kerr & Co. are still crowded with orders. Last month their sales of engines amounted to 110, with an aggregate horse power of 6,035. Mr. Church is at present in the West.

Highgate, Vt.—The Swanton Electric Light Company has purchased a new mill power, with the intention of lighting Swanton. Water power will most probably be used, there being an estimated fall of 30 feet.

Mr. W. J. Fraser, the popular manager of the Rye Beach Station of the Direct United States Cable Company, has left Rye Beach for the season, and will make his headquarters in Boston for the winter, visiting Rye Beach periodically.

Pettingell, Andrews & Co. have received an order from the West End Street Railway Company for a very large quantity of line wire. P. and B wire will be used, part being 100,000 circular mils and part 200,000, and it will be made flexible for easy handling.

Newburyport, Mass.—The electric car which has been in use here for a few weeks has proved such a success that the Newburyport & Amesbury Street Railroad Company have determined to equip the entire eleven miles of the main line with the Thomson-Houston system.

New Haven, Conn.—Prof. Hastings is making quite a success of the course in electricity opened at the Sheffield School of Yale University. Much of the necessary apparatus is already supplied, and every effort is being made to make it as popular as the other scientific courses.

Mr. W. J. Morrison, of the Fort Wayne Electric Light Company, called at this office on his way home from Halifax, where he has sold several machines. Mr. Morrison reports business very good with the Fort Wayne Company, and the prospects extremely bright for a good season next year.

Visitors in Boston.—Mr. George L. Wiley, of the Standard Underground Cable Company, Mr. George T. Manson, of the Okonite Company, and Mr. Henry D. Stanley, of the Bridgeport Brass and Copper Company, have been favoring their many friends in Boston with a visit this week. No blood was shed.

J. A. Grant & Co., of Boston, are engaged in the installation of a complete steam plant for the Thomson-Houston International Company at San Luis Potosi, Mexico. The plant comprises two boilers, 100 h. p. each, with engines and all the appurtenances for a first-class steam plant, and the work of construction is now being carried on.

Randolph, Mass. At a special meeting of the Board of Selectmen this afternoon, a franchise was granted the Randolph & Holbrook Light and Power Company to establish and operate a plant in this town. One of the conditions is that the electric railroad will be built on or before the first day of April, 1890, and the Selectmen have received a guarantee to that effect. The company propose to use the Thomson-Houston system.

Cambridge, Mass.—The Cambridge Electric Light Company have placed an order with J. A. Grant & Co., of this city, for two more McIntosh & Seymour tandem compound engines of 200 h. p. each. So great has been the growth of the electric light business of this company that they have been compelled, temporarily, to abandon the work of furnishing power from their station for the cars on the Cambridge Division of the West End Street Railway Company until the additional engines are placed.

Control of Electric Wires.—At a special meeting of the Boston Common Council, held this week, the Mayor was instructed to petition the Legislature for an act giving the city further control of the erection and maintenance of all electric wires, with authority in all cases to require suitable insulation and to compel the removal of all disused wires; also the power to regulate the intensity of the electric currents and such other powers as may best protect the public in the use of electric wires wherever placed. The order was passed and reconsideration refused.

Mart n's Thermocall.—I happened to see the inside workings of one of Mr. Martin's electric thermocalls the other day and was much struck with the extreme simplicity of this valuable instrument. Although the instrument complete sells for only two dollars it is so sensitive that it will set an electric bell ringing by merely breathing on it for the fraction of a second. Mr. Martin is busy sending them all over the country, and receives frequent orders from abroad. In any place where it is important to have a uniform temperature this little instrument must form a valuable addition to the fittings of the room.

Institute of Technology. Boston.—The New England Weston Company have sold to the Institute of Technology a 500-light dynamo of 110 volts to light up their building. This is the second dynamo the company has furnished to the Institute, the first being used chiefly for laboratory purposes. This dynamo has proved very satisfactory to the professors, though it has often been loaded away beyond its normal capacity. The Institute is making a special feature of its electrical engineering course, and this new dynamo will doubtless furnish a large field for an exhaustive analysis of the mysteries of winding and compounding.

Tripp Roller Bearings.—The Tripp Manufacturing Company are beginning to find a large field for their frictionless roller bearings among the electric companies. These bearings have been applied to the trolleys of a number of the cars of the West End Street Railway and also of the Albany Street Railroad. The Chicago Arc Light and Power Company have used them with great success on their line shafting, and a number of bearings have been shipped to the Thomson-Houston factory at Lynn. As these bearings require oiling only about once a year, and develop no heat, being almost without friction, they should be invaluable for numerous electrical enterprises.

Magazine Fuse Boxes.—This useful device, which was recently described in the columns of THE ELECTRICAL WORLD, is meeting with much success among the electric light companies. It is the invention of Mr. W. S. Hill, of 133 Oliver Street, Boston, and as it becomes better known will be a necessity with all electric light companies. It is designed to do away with all possible danger in renewing fuses while the current is on. When one fuse is burned out, all that is necessary is to turn an insulated handle and another fuse is immediately inserted in circuit in the place of the one burned out. Every station superintendent should investigate this device, as it is sure to save him a great deal of annoyance, and prevent any possibility of accident to his linemen.

A Conduit Commission for Boston.—At a meeting of the Board of Aldermen held this week an order was presented requesting the Mayor to petition the Legislature at its coming session for the passage of an act authorizing the Mayor of the city of Boston to appoint three able and discreet persons, who shall receive a salary of not less than $3,000 each per year, with power sufficient to superintend the construction, maintenance and operations of the work of all private corporations that occupy a space under any street more than 18 inches beneath the surface; also that all proper and necessary expenses incurred in the discharge of their duties, and the salaries of the commission, shall be apportioned in an equitable manner and borne by all corporations affected by this order.

Insurance of Workmen.—The losses which arise from claims for accidents to workmen, and the long, wearisome litigation which these claims often entail, have been in the past few years a matter for most serious consideration to employers of labor. Many a manufacturer has ardently wished that there might be a solution to this difficult problem, or that at least he could in a measure estimate the amount which would be necessary to meet these difficulties; but nothing seemed to offer itself as a relief to the already harassed and careworn employer. He was often obliged to pay large sums of money out of the earnings of perhaps a not particularly profitable year, on account of some unforeseen accident, when he had taken every precaution which lay in his power to prevent it. In 1886, however, the Employers' Liability Assurance Corporation, of England, decided to extend their business to this country, and to this end appointed Messrs. Endicott & Macomber, of Boston, their managers for the United States, with agents in almost every city of the Union. Manufacturers and contractors all over the country are beginning to realize and appreciate the load which is lifted from their shoulders by insuring in this corporation, and already employers of labor with pay-rolls of over $75,000,000 have protected themselves. The premiums are moderate, being based upon the yearly pay-roll. During the time of the insurance the company assumes all risks and pays claims which may arise on account of accidents, and defend with eminent counsel all suits which may be brought, the employe having no care or responsibility in the matter. This is, indeed, a boon to manufacturers and employers of labor generally, and I advise them to lose no time in protecting themselves in this comparatively easy manner, thereby lifting some of the heavy weight of their troubles and anxieties.

The Electric Piano.—A most interesting musical novelty has just been brought before the Boston public, and the first exhibition given in this city, of an entirely new invention in electricity, being nothing less than an ordinary piano, played with marvelous execution and expression by simply introducing the electric current. If the opinion of persons who have seen and heard it may be taken as an indication, this invention is bound to become immediately an important factor in musical circles and entertainments. Apparently it was the idea of the inventor to have the electrical appliance supply exactly the place of the absent human player, but in no way to obstruct or affect the ordinary use of the piano when desired to be played in the same way. The electric stroke is made at the back of the key, throwing it up, and thereby causing the hammer to strike the string, giving exactly the same motion and effect as produced by the human player when at the key-board, and not changing the regular working of the piano in any way. The force of the electric blow to produce a loud or soft note is under perfect control. The modus operandi of all this is very simple, being nothing more than the old and well-tried appliance of the magnet and armature, familiar to every one who has ever seen a telegraph "ticker." A rapid, certain and durable means of producing the makes and brakes was necessary to the success of the piano, and it is here that the inventor has gone ahead of all other attempts in the field of invention, and produced a most ingenious and simple method of accomplishing the desired result. A spool of paper represents the music to be played in it; the notes are perforated, instead of printed, as in ordinary music. The paper passes over a small rest (called the tracker board), in which are a number of holes or air channels, corresponding to the keys of the piano, and through each one of these holes the air passes to a little pneumatic chamber placed under the rest (one of these to each key), and all of them enclosed in an air-tight box. As soon as the piano is set in motion, the spool revolves, the paper passes over the rest, in which are the little air channels, and when a perforation in the paper comes to correspond with a channel in the rest, a current of air is drawn into the pneumatic chamber, expanding it to the fullest extent. On the bottom of this chamber is a metal spring, and as the expansion takes place, this meets a contact point arranged for it; this closes the circuit, and the stroke is made by the keys. When the perforation has passed the air channel, and the solid paper again covers it, the chamber below is relieved and under pressure of the spring, and the circuit is broken; the instant another opening appears, the operation is repeated, and so on. In the paper music sheet the perforation marks the duration of the note, and its relation to the other notes of the piece being played. The tempo is governed by the speed with which the paper passes from its spool. As this is rotated by a small wind motor, moving fast or slow, as much or as little air as desired can be admitted; a single slide stop brings the entire instrument under perfect control. The electric current required to operate this instrument is very small and the voltage low, not exceeding eight volts, and is absolutely harmless under any circumstances. The method adopted to obtain this light current has been to use storage cells charged from the ordinary gravity battery or from any of the street wires. A. C. S.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Nov. 16, 1889.

Detroit & Birmingham, Mich., may be connected by an electric street railway before 1890.

The Liberty, Mo., Electric Light Company will add an arc plant to be operated in connection with their present Heisler incandescent system.

Mr. Wm. D. McQuesten, of New York, has been visiting friends in St. Louis and Kansas City during the past week, and is cordially welcomed everywhere.

Mr. Foree Bain has been making a photometric test of the arc lights supplied to Racine, Wis., by the Racine Gas Company, and reports them to range from 1,197 to 1,425 c. p.

Lodge, Davis & Co., of Cincinnati, Ohio, have incorporated under the name of the Lodge & Davis Machine Tool Company, capital stock $500,000. They are running full of orders. Trade has increased largely with them over last year, and prospects are very good.

Mr. C. E. Carpenter, of the Nevens Electro-Heating Company, of Minneapolis, has been consulting with his attorneys in Chicago regarding foreign patents. Mr. Carpenter's atmospheric heater is remarkable for its simplicity and the results obtained by its use.

The Pumpelly Storage Battery and Electric Motor Company, of Chicago, have issued a convenient little work descriptive of storage cells and containing directions for their use, that will be mailed free on application, and will be found very useful by all employing secondary batteries.

The Aladdin Manufacturing Company, of Kansas City, Mo., has been incorporated by A. B. Wilson, W. S. Stone and E. C. Sattley, with a paid in capital stock of $100,000, divided into 10,000 shares of $10 each, each party holding a one-third interest. It is proposed to manufacture electric motors, dynamos and other apparatus.

Mr. W. G. De Celle, secretary of the Northwest Electric Construction and Supply Company, of St. Paul, Minn., visited Chicago on business this last week. Mr. De Celle speaks in glowing terms of the business outlook throughout the Northwest, and is of the opinion that the admission of the new States will largely add to the general prosperity.

The Chicago, Milwaukee & St. Paul vestibuled train brought a large number of the delegates returning East from the meeting of the American Street Railway Association at Minneapolis, and though several extra coaches had been added to accommodate all, yet the train arrived in Chicago exactly on time. The delicious breakfast served in the dining car, as well as the perfect service rendered, was remarked by all.

Mr. J. C. O'Gorman has now control of the interest of the United States Electric Company in the Stillwater, Minn., Electric Light Company, and a new plant will be erected just north of the old Isaac Staples mill, the power for the dynamos being furnished by the Stillwater Construction Company. A much cheaper light for private residences will be supplied and the plant nearly doubled. The works at the old Florence mills will be closed.

Mr. D. A. Andrews, Jr., of Pettingell, Andrews & Co., Boston has arrived in Chicago, en route home from an extended trip through the South and a portion of the West. Mr. Andrews states that business is good everywhere, and especially so in St. Louis, where their representative, the Southern Electrical Supply Company, have all the business they can possibly take care of, though their working force has been increased from time to time and their quarters extended.

Mr. F. W. Cushing, of Chicago, one of the best-known members of the electrical fraternity in the West, has severed his connection with the Western Electric Company, and is about to branch out in the supply business as secretary of the Central Electric Company, Chicago. Mr. Cushing's wide experience in all the branches of electricity will stand him in good stead. He resigned the position of superintendent of the underground conduit company to assist in organizing the Chicago Arc Light and Power Company, of which he remained the superintendent until ill health compelled him to seek less active employment. Mr. Cushing has made several trips to Europe, and represented the interests of Prof. Elisha Gray at the former Paris Exposition.

Rockford, Ill.—The Rockford Electric Manufacturing Company, who manufacture Mayo dynamos, motors, etc., are doing an excellent business. They are employing 30 men daily till 9:30 P. M. They are building arc dynamos to run 80 lamps of 2,000 c. p.; incandescent machines from 20 to 800 lights, and motors from ½ h. p. to 50 h. p. of any desired voltage. Their sales for the last week of October included a complete plant of 75 incandescent lights to the Forsythe, Ga., Cotton Mills; a 100-light incandescent plant complete with Rice automatic engine, to B. R. Mayer; two 75 h. p. generators and two 1 h. p. motors to the Rockford Electric Power Company and one 25-light dynamo and one 100-light to the Commercial Electric Company, of Detroit. The electrician of the company is George A. Mayo.

Canton, O.—The scheme proposed some time ago, by Judge J. P. Fawcett, to the Lake Side Street Railway Company, to extend its lines to Massillon, O., has assumed definite shape, and solicitors have been appointed to secure the right of way, and the route will be surveyed within a few days. The capital stock of the company has been increased from $50,000 to $100,000. The company will build two power houses, halfway between the two cities, which are nine miles apart. Cars will be running by April 1, 1890. The Canton Street Railway Company will extend their lines early in the spring, covering the western and southwestern parts of the city. The additional roads will be about four miles long. The company are advertising their horses and old cars for sale, and expect to have electrical cars running by Feb. 1, 1890.

Mr. J. W. Hoffman, superintendent of the electrical department of the Pullman Car Works, has an extensive workshop under his charge, with a large force constantly employed in making annunciators, push buttons, bells and disque Leclanche batteries, all of which are used in the Pullman coaches. Every coach now sent out is wired throughout for electric lighting as well as for annunciator service, and where storage cells are placed on the coach for lighting purposes, two cells are connected in circuit with the annunciator, thus dispensing with the ordinary porous cup cell employed. The handsome lighting fixtures are finished in this department, and the motors operating the fans in the dining cars are constructed throughout in this department. The ample facilities at Mr. Hoffman's disposal have enabled him to perfect many devices required in train service.

An Electrical Rainbow.—A prismatic rainbow of enormous size arching from an anchorage in the lake to a point in the Exposition grounds was suggested to Mr. Edison by Henry A. Spaulding, the Chicago representative at the Paris Exposition. Mr. Edison is reported to have said: "It is feasible beyond a doubt, and it can be made so close an imitation of the most brilliant rainbow ever seen in the heavens as to absolutely deceive many of those not in the secret." It is proposed to make the frame-work of the great arch

as light as possible, so that the rainbow-hued bulbs of incandescent lights will appear unsupported. As soon as Congress awards the World's Fair prize to Chicago, Spaulding & Co. intend making a model of the rainbow, using silver for the frame-work and, and for the electrical colors, the three and six candle-power lamps, made by the Edison Lamp Company, of Harrison. N. J.

Dr. Eben D. Cross, of Chicago, whose primary battery was recently illustrated and described in THE ELECTRICAL WORLD, reports having made several improvements in the minor parts of the cell, and now has a dozen 20-volt Edison battery lamps, a Sperry arc lamp and a C. & C. motor connected on different circuits to 17 cells. Dr. Cross also reports having sold the right to handle his cell in the State of Missouri for $100,000 to a St. Louis company. The success reported by Dr. Cross has induced a gentleman to devise a cell which will shortly be placed on the market by a company who propose to furnish, operate and maintain a battery of sufficient size to furnish the desired quantity of light at a price not to exceed double the rates that an equal quantity of gas light will cost. The plan also includes the economical recovery of the zinc from the sulphate by means of a simple and inexpensive process. So it is claimed.

Theatre Lighting.—The Windsor, a cosy family theatre on the north side, near Lincoln Park, was the scene of a brillant reception on the 8th inst., the occasion being the illumination of the interior with nearly a thousand Edison incandescent lights. Mayor Cregier and other notables were present, and after careful inspection pronounced the display an entire success. The plant and wiring was installed by the Chicago Edison Company, under the direction of Messrs. Ghoest & Ferguson, and consists of two 25,000-watt Edison dynamos coupled to a Russell 80 h. p. engine, secured from Rice & Whitacre, of Chicago. The remodeled Casino, a second North Side theatre, located just across the Clark street bridge, was also reopened last week with a blaze of light from a Thomson-Houston plant, consisting of a 500-light incandescent and a 30-light arc dynamo, belted to a 100 h. p. New York Safety engine. Both the exterior and the interior of the building are thus flooded with the soft brilliancy, and this decided improvement has tended to change the class of patrons and largely increase the receipts.

Solving the Smoke Problem.—The central lighting station of the St. Paul Edison Electric Light & Power Company is located just within the borders of the resident portion of the city, and the volume of smoke that formerly rolled out of the tall chimney became so great a nuisance that a delegation of citizens threatened an injunction suit unless steps were taken to lessen the evil. So the general manager, Mr. George H. Finn, had the McGinnis device placed under the old boilers at an expense of about $175 each, since which date there has been no complaint about the smoke. The device consists of two brick fire arches and a heavy brick wall, while in front are two heavy iron plates placed in an inverted Λ shaped form. These plates control the admission of air, and are manipulated by a ratchet movement. While firing up there is a slight escape of smoke from the chimney, but otherwise nothing but an occasional light wreath of smoke is perceptible. Mr. Finn believes that economical success can best be secured by having an intelligent fireman who will endeavor to keep the thick bed of coals as level as possible, that perfect and equal combustion may go on throughout the entire mass of fuel; and he has also observed that by using a grade of coal costing over one dollar per ton more than was formerly paid, he has secured far better results in evaporation of water, and effected an actual saving of some 30 per cent. in the total average amount paid for fuel.

A Model Installation.—The twelve-story granite and red sandstone structure now being erected in Minneapolis by the Northwest Guaranty Loan Company, and which will be, when completed, one of the most elegant and convenient office buildings in the country, is now being wired for an incandescent and an arc lighting system, preparations being made for the ultimate use of some 3,000 Edison lamps. The wiring is being done on the three-wire Edison plan, convertible to simple multiple arc by simply closing one switch, each wire or section thereof running from cut-out to lamp outlet without any break in the insulation, or the employment of short lengths soldered or joined together; in fact, there is not a joint made or a particle of solder used in the wiring of the entire building, only full lengths of wire being used. Edison dynamos of a capacity of 2,000 16 c. p. lights are now being installed, to be operated by two 100 h. p. Ball engines, the additional machines to be placed in position later on. The switchboard will be supplied with all the improved devices, and so connected with the local central Edison station that should an unforseen accident necessitate the shutting down of one or both dynamos, the opening of one switch and the closing of a second will connect the building with the central station, and thus obviate any annoyance from absence of lights for any greater length of time than is required to start the extra engines and dynamos held in reserve at the central station for such occasions.

All the arc light wires are to be placed in the tubes furnished by the Electrical Supply Company, which are concealed beneath the plaster. The grand arcade will be lighted by fifteen arc lamps in addition to the incandescent, while arc lamps will be placed in front of the building. The arrangement of the incandescent lamps within the vestibule and the arcade will be unique and elaborate, the designs being entirely original and in harmony with the interior decorations. In fact, Mr. Arthur S. Huey states that no expense will be spared to make this installation a model one in every sense of the word, and one that can be inspected with profit by all architects and engineers. Mr. Huey is to be congratulated on having secured this excellent opportunity for proving how perfect a system of lighting may be made in any modern structure where the owners will allow reasonable compensation for the superior class of work required, while the Guaranty Loan Company are to be congratulated on the wisdom and forethought thus displayed.

F. DEL.

MILWAUKEE, Wis., Nov. 5, 1889.

Merrill, Wis.—The City Council has accepted the offer of the Merrill Electric Company to light the streets for eight years.

Eau Claire, Wis.—The Eau Claire City Railway Company commenced the operation of its line by electric power this afternoon, on the Sprague overhead system. The last span of mules was sold to the Marinette Street Railway Company.

The West Side Street Railway, now operated by horse power, is to be changed to an electric road. Contracts have been signed whereby the Sprague Electric Railway and Motor Company agrees to have the cars running by electricity by Feb. 1 next.

Underground Wires.—An ordinance has been introduced in the Common Council to compel the placing underground of all wires on the East side. The telephone wires are going underground now, and this ordinance will affect only electric light and telegraph wires. It is expected that the ordinance will arouse considerable opposition.

Twelve Motor Cars are being built at St. Charles, Mo., for use on the Hinsey electric railway. The cars will be 18 feet long and will have a platform at each end, so arranged as to give room for the man controlling the motor. It is intended to run the cars in trains of three, one motor car being capable of drawing two others of the ordinary sort.

The Holmes Protective System.—The trial in the case of Thos. Ramsey against the Holmes Electric Protective Company, which has occupied the attention of the United States Court, ended with a verdict in favor of plaintiff, the jury awarding him $827 damages. Ramsey had assumed the agency for the Holmes Electric Protective Company, which afterward had been assumed by the Wisconsin Telephone Company, contrary to the stipulations of the contract entered into by the litigants. G.

ENGLISH NOTES.

[*From Our Own Correspondent.*]

LONDON, Oct. 30, 1889.

The Operative Electricians' Union.—The electrical trades union movement continues to grow. Another large meeting was held in the city last week, when it was announced that the title of the new union was to be the "Operative Electricians' Union," and that support was coming in from all sides.

Proposed National Memorial to the Late Dr. Joule.—A proposal to erect a national memorial in Westminster Abbey to the late Dr. Joule has been set on foot, and a committee composed of the leading English men of science has been formed to take the matter in hand. Few men have better claim to this distinction than Dr. Joule, whose work ranks only second to that of Newton. The discovery of the mechanical equivalence of heat and the theory of the indestructibility of energy, are achievements which certainly call for some fitting memorial, and there can be little doubt that this proposal will meet with the earnest support of all who are able to appreciate the great value of Dr. Joule's labors.

Electrical Exhibitors at Electrical Exhibitions.—At the last meeting of the electrical section of the London Chamber of Commerce a somewhat revolutionary proposition was brought forward by Major Flood-Page, secretary to the Edison-Swan Company. As your readers are already aware, it is proposed next year to hold an electrical exhibition in Edinburgh. Major Flood-Page's suggestion is that since the success, financial and otherwise, of these exhibitions depends so much upon the enterprise of electrical exhibitors, it is high time for the industry to stand firm and refuse —not to exhibit, but to pay heavily for being allowed to exhibit. It is impossible not to sympathize with this movement, and if the electrical industry is united we shall probably see the overthrow of a system which did very well when electricity was content to exist on suffrance, but which is now out of date.

The London County Council and Overhead Wires.—Coinciding with the somewhat sensational news on the subject of the overhead wires on your side of the water, we have the London County Council drafting a brief and business-like bill to be laid before Parliament next session, which will confer tolerably wide powers upon this body in dealing with the overhead wire question as it presents itself in this city. The bill compels the owners of overhead wires to annually register the same, allows the County Council to remove ownerless wires, and provides for the inspection and proper erection of all aerial lines. In short, it confers just the powers that are needed to prevent overhead wires from becoming the nuisance and danger they appear to be in New York. Of course the work of the Council in this direction will be considerably narrowed owing to the fact that all electric light companies have to put their wires underground by the provisions of their franchises, so that telegraph and telephone wires will be the only ones which will be affected.

Mr. Crompton on Transformer Working.—In a lengthy letter to the *Electrical Review*, Mr. Crompton endeavors to show that the tendency toward the transformer system of distribution, which has been so marked of late both in Europe and America, is an entirely mistaken tendency. Taking for his text the 18.6 pounds of coal per horse power hour consumed in the lamps, which it seems is the figure at Brighton, Mr. Crompton proceeds to show that nothing better could be expected. According to him the mean efficiency of an ordinary-sized transformer for the whole year is" but little more than 50 per cent., and the commercial efficiency of the system does not, as a rule, exceed 30 per cent. However, granting all this to Mr. Crompton, which I am inclined to think most transformer men would hardly do, the fact still remains that the alternate-current transformer method of distribution enables those who employ it to profitably light areas which could not be touched by any low-tension system; and it has yet to be shown that the *total cost* of operating a transformer plant compares unfavorably with that of any low-tension system.

THE TELEGRAPH.

The Satsop Railroad Company, of Seattle, Wash., proposes to supplement its road with telegraph and telephone lines.

Port Townsend, Wash.—The American District Telegraph Company of Port Townsend has been formed by N. J. Levinson, R. E. Moody, and others, with a capital stock of $20,000.

Determining Longitude.—Lieut. Norris and other officers have sailed on the "Yantic" for the West Indies, to determine the longitude of various important places with the aid of telegraphy.

Seattle, Wash.—The Puget Sound & Great Eastern Railway, Telegraph and Navigation Company has been formed by J. Arthur, H. M. Crocker, W. Collier and J. L. Murphy, with a capital stock of $6,000,000.

The Postal Telegraph Cable Company are erecting a new line from Buffalo, N. Y., via Lockport, Medina, Albion, Brockport, Rochester and Syracuse, thence to Elmira. The Lockport Common Council have granted the company the privilege to enter the city and erect their poles.

THE TELEPHONE.

The Chicago Phonograph Company has been formed by C. W. Drew, F. S. James and W. M. Tyler, with a capital stock of $750,000.

The Arkansas Territorial Telephone Company has been formed by J. R. Davis and J. K. Perry, of Dardanelle, and others, with a capital stock of $50,000. It is proposed to build telephone lines at once. Mr. Perry is president of the company.

The Government Telephone Suit.—At Boston, on Nov. 15, in the United States Circuit Court, arguments were heard on a motion of the Bell Telephone Company in the suit of the United States against the Bell Company, for an order to restrict the taking of testimony solely to the question of fraud. George A. Jenks and Charles S. Whitman were for the Government, and the Bell Telephone Company was represented by Elias Merwin and Chauncey Smith. Judge Colt, after hearing the arguments, said there was no precedent for the granting of such an order as that asked, and the order would not be granted.

THE ELECTRIC LIGHT.

Abilene, Tex., is forming a local company.

Mammoth Spring, Ark.—The Crescent Roller Mill Company will put in a plant of 50 incandescents.

Wheeling, W. Va.—The Wheeling Electric Light Company are increasing their steam and electric plant.

Jeffersonville, Ky.—The Jeffersonville Electric Light Company has secured the contract for city lighting.

Suffolk, Va.—Electric light plants will be put in by the Gay Manufacturing Company and the Southern Lumber Company.

Arkansas.—The Hope Lumber Company are putting in a plant. The White River Stave Company propose putting a plant in their factory.

Chatham, N. Y.—The Chatham Electric Light Company has been formed by J. Morehouse, C. R. Dean and others, with a capital stock of $15,000.

Rutherford, N. J.—Mr. Bert Buys, formerly with the Erie Railroad, has been appointed electrician of the Rutherford Electric Light Company.

Collingwood, Can., has contracted for a plant for 30 "Reliance" arc lights of 2,000 c. p. and 600 incandescents of the Slattery alternating system.

Orange, N. J.—A company is being formed to consolidate the electric lighting interests in the Oranges. The capital stock will be fixed at $1,000,000.

Huntington, N. Y.—The Empire Gas and Electric Light Company has been formed by G. Olney, C. A. Godley and others, with a capital stock of $200,000.

Sehome, Wash.—The Fairhaven Electric Light Power and Motor Company will put in an electric light and power plant for all purposes, at Sehome.

Merrimac, Mass.—The new Merrimac Electric Light Company has a capital stock of $10,000. Mr I. B. Little is president and Mr. T. T. Robinson treasurer.

The Winnipiseogee Gas and Electric Light Company has been formed at Laconia, N. H., with a capital stock of $50,000, by J. S. Crane, B. F. Drake and others.

Cowansville, Can.—The Cowansville Electric Light Company has been formed by G. E. Lowd, G. K. Nesbitt, C. L. Cotton and others, with a capital stock of $12,000.

The Laredo, Tex., Improvement Company have telegraphed THE ELECTRICAL WORLD that they are in the market for a plant of 50 arcs of 2,000 c. p. and 1,000 incandescents of 20 c. p.

Winston, N. C.—The Winston Electric Light and Motive Power Company are busy putting 600 incandescent lights into houses, churches and factories. Mr. J. W. McFarland is the superintendent.

Blacksburg, S. C.—The Blacksburg Land and Improvement Company has been formed by J. F. Jones and F. Cox, of Asheville, and others, with a capital stock of $10,000. It will put in an electric light plant.

Wabash, Ind.—The local company, G. Webster, Jr., Secretary, are about to double their present incandescent plant, and to use the addition for commercial purposes. They will probably put in Heisler plant.

The Thomson-Houston Electric Company have, with customary enterprise and liberality, invited the Pan-American delegates to visit Boston, and have offered to put a special train at their disposal any day they may name.

Harrodsburg, Ky.—The Harrodsburg Electric Light and Power Company have now purchased a plant from the Fort Wayne-Jenney Electric Company of the Slattery alternating system, for street lighting, etc., and have a contract with the town for ten years.

Columbia, Tenn.—The Columbia Improvement Company is operating the local gas, water and electric light plants, the latter consisting of 50 arcs and 600 incandescents. It is now putting in a 100 h. p. Dick & Church engine, to be running in a fortnight. Mr. E. Yoest is the electrician.

Baltimore, Md.—George S. Batcheller, Acting Secretary, Treasury Department, Washington, D. C., will receive proposals until Nov. 27, for supplying and placing in position in the United States Court-house and Post-office building, Baltimore, Md., combination electric light and gas fixtures.

The New Talmage Tabernacle, in Brooklyn, will be a magnificent building, to hold 5,000 persons. It will be lighted by electricity, and there will be special illuminating effects in connection with the organ, which will be surmounted by a crown of electric jewels, while on the huge sounding board will be either a lamp or a star in incandescent lamps.

Americanizing China.—J. F. Donahue, who sails for China on the 9th as superintendent of the Canton Electric Light Company, will take a complete machine shop, comprising lathes, shapers, drills and planers and a force of 10 skilled mechanics from this city to operate them. The employés go out on a three years' contract, fares to be paid both ways and salaries guaranteed by a bond made by wealthy Chinamen, residents of this city.—*Pacific Lumberman.*

St. Louis, Mo.—The United Electric Light and Power Company, which has been purchased by the Hollins syndicate of New York, has reorganized its board of directors as follows: H. B. Hollins and C. F. Stone, of New York; W. L. B. G. Allen, Alex. Ross, J. D. Thompson, David R. Powell and Emerson McMillin, of this city. Mr. Allen was chosen president and Mr. Thompson secretary and treasurer. The company's office will be in that of the Laclede Gaslight Company, both being owned by the Hollins syndicate, and Mr. Thompson being secretary of both.—*St. Louis Post-Dispatch.*

The Easton Electric Company, of 45 Broadway, this city, has just concluded a contract with the city of Rockland, Me., by the terms of which the company is to light the streets of that city for a period of five years. The Easton Company has been recently reorganized, and its present officers are President, P. Minturn Smith; Vice-President, Wm. D. Perry; Secretary, G. G. Frelinghuysen; Treasurer, Charles Tremaine; Electrician, James W. Easton. The new management is putting a great deal of energy into the business, and invites investigation for the system. Its management claim that the dynamos and lamps are the best proportioned, electrically, and the simplest, mechanically, of any thus far devised.

Storage Battery Street Lights.—The following is from the New York *Sun*: "It is said that Mayor Grant's actions in regard to the electric lights will have the effect of pushing through an invention which does away with poles and the tearing up of the streets. No wires at all are required, and the single question of economy has finally been solved. The system of storage batteries on which the electricians have been working so long, and which has been partially successful in the electric street cars, has been applied to lamp-

posts, so that one of the most vexatious problems in the domestic economy of a great city is practically solved. Enough electricity can be stored in the base of a lamppost to keep the light burning for two nights, eight hours each night, and there is an automatic arrangement by which the light is extinguished after it has burned any given length of time."

APPLICATIONS OF POWER.

Racine, Wis.—The Belle City Street Railway Company is to put in its electric plant next spring.

Bloomington, Ill.—The B. & N. Railway has already ten miles of track, and will have the Daft system in operation in a few weeks.

Seneca Falls, N. Y.—The Seneca Falls & Waterloo Railway has been bought by C. Roe, of Rochester, and is to be run electrically.

Springfield, Mo.—The Citizens' Street Railway Company has asked for permission to change from horses to electricity, and for an extension of its franchise.

Little Rock, Ark.—The Little Rock Street Railway Company is adopting electricity, and will spend $75,000 on improvements—a power plant with two 150 h. p. engines.

Washington Territory.—The Jackson County Electric Railway Company has been formed at Seattle by W. H. Lewellyn, J. F. Eshelman, W. W. Kirkwood and others, with a capital stock of $50,000.

Seattle, Wash.—The Ranier Power and Railway Company is to operate cable and electric roads, it is said, in Seattle. The capital stock is $100,000. G. Kinnear, D. T. Denny, R. S. Greene and others are interested.

Sherman, Tex.—The Sherman & Denison Electric Railway and Power Company has organized with N. M. Lee, as president; C. W. Lewis, secretary, and A. W. Atkinson, treasurer. The road, which will be built immediately, is about seven miles long. The capital stock is $300,000.

Syracuse, N. Y.—The Syracuse, Eastwood Heights & DeWitt electric road is in course of construction. Mr. N. L. Williams is president: Mr. R. N. Gere, vice-president, and Mr G. B. Leonard, secretary. The road will be four miles long and will be operated on the overhead system.

Rochester, N. Y.—The Rochester City and Brighton Street Railway has been sold to a syndicate of Pittsburgh, New York, Philadelphia and Rochester capitalists for $2,175,000. The purchasers take 4,700 of the entire 5,000 shares of stock at $200 per share, or at the rate of $1,300,000 for the whole. They also assume the bonded indebtedness of $875,000. At the sale the purchasers were represented by M. A. Verner of Pittsburgh, and Theodore Frothingham and De Witt Cayler of Philadelphia. Mr. Verner represents Messrs. Sellers & McKee and others of Pittsburgh. Of New York capitalists, it is believed that Mr. Drexel, of Drexel, Morgan & Co. is interested, and of Philadelphia capitalists, E. W. Clark & Co., bankers. Local capitalists take one-fifth of the stock. The purchasers have also bought the franchises of the new Crosstown Railway Company for $75,000, and will have a monopoly of the street railroads in Rochester. Electricity is to be applied all over the system.

The Taylor & Brunton Sampling Works, of Colorado, running on boulder (lease) ores, are now running a 30 h. p. Sprague electric motor in their works, with very gratifying results. Ten horse power is all that is required to drive the machinery, leaving 10 h. p. to use for other purposes. The motor is doing the work with the greatest ease, running smoothly, with no jarring or hitching. Electricity is being used in quite a number of mining plants throughout the country, and all who have used the Sprague motors have spoken of them in the highest terms of praise. The immense amount of saving in power, fuel, etc., is an item which all mining operators are interested in. The Sprague Company guarantee more power transmitted for amount of fuel used than can possibly be gained by any other method of transmitting power, and to mining operators, where the source of power is at a distance from the plant, there are no means so adaptable as the electric motor. The company are now represented in their handsome new offices in the Rialto Building, Chicago, by Mr. H. McL. Harding, where they will be glad to see any interested in the subject, and will be glad to furnish any information in regard to their motors.

PERSONALS.

Mr. Wm. Maver, Jr., lectured recently before the New York Young Men's Christian Association on the telegraph, past, present and future.

Mr. Chas. A. Schieren, of the firm of Chas. A. Schieren & Co., has been appointed one of the Committee of the New York World's Fair of 1892, to represent the leather industry.

Mr. R. P. Sellon, who is well known in this country, has been visiting Ceylon in the interests of the Anglo-Brush Corporation, who expect to open up a new field in that colony on the estates.

Mr. George F. Porter, long and well-known in the arc carbon industry, has joined the forces of the Westinghouse Electric Company. He is a man whose ability and energy will soon make themselves felt in his new sphere of labor.

Mr. J. J. Carty, electrician of the Metropolitan Telephone Company, will read a paper at the New York Electric Club on November 21, at 8 P. M., on "A New View of Telephone Induction." It will be preceded by dinner and followed by a lunch.

Mr. C. W. McKibben, telegraph operator at Lima, O., writes us, proposing as a feature of the Exposition of 1892, that the various electric companies combine to build a dynamo of 15,000 h. p., run by a triple-expansion engine and energizing an arc lamp with carbons six feet long and a foot thick, placed as a search light on top of a huge tower. He would then charge 25 cents admission to see the engine and dynamo.

Prof. John Trowbridge has an interesting story in Mrs. Burnett's "Youth's Department," of the Sunday papers, entitled "A Chase by Electricity," wherein he graphically depicts the successful efforts of a young electrical student to frustrate the actions of a brace of robbers, both of whom are finally killed by the current while cutting the trolley wire in the endeavor to prevent a second car running on the line. The only part wrong is that the railway current now in use does not kill.

Dr. Louis Bell, late professor of physics and electrical engineering at the Purdue University, La Fayette, Ind., has become a resident of Chicago, and has entered into a partnership with Mr. Geo. H. Bliss, the well-known electrical expert and financier, under the firm name of Bliss & Bell, with the object of securing electrical expert work and engineering, and to fill the same relative position in the electrical field that an architect does in the construction of buildings, but not to become contractors. Dr. Bell graduated at Dartmouth College, and then passed four years at the Johns Hopkins University, where he received the title of Doctor of Philosophy. While at the State University at La Fayette, Dr. Bell devoted his time largely to the subject of electric propulsion in connection with street railway systems, and devised several improvements in apparatus pertaining to street car mechanism. Last year he made an exhaustive test showing the economy and efficiency of a street railway system, placing members of his graduating class in the boiler room to weigh the coal and measure the water fed to the boilers, to indicate the engine record, the work of the dynamos, and to measure the current used by each car. The combined reports were of great value, as proving conclusively how profitable the operation of a street car line can be made where proper care and management is shown. The field to be covered by Dr. Bell is ripe for so brilliant an expert.

MISCELLANEOUS NOTES.

The Edison Ore Separator is to be tried at the Lorraine Iron Works in Germany.

The Webster Process for treating sewage electrolytically is to be tried on the Medway, Eng.

The Electrical Invention Company, of Detroit, Mich., has been formed with a capital stock of $100,000.

The Westinghouse Machine Company are improving their Pittsburgh shops to the extent of $20,000.

Seattle, Wash.—The Cascade Water Power, Electric and Improvement Company has been formed by J. Arthur, H. M. Crocker, W. Collier and J. L. Murphy, with a capital stock of $1,000,000.

The Standard Electrical Works, of Cincinnati, report, through President Cherry, that the Perry amalgamated zinc is meeting the want that has long been felt for a zinc of that kind.

Moffett, Hodgkins & Clarke, the engineers and contractors of Watertown, N. Y., have removed to Syracuse, N. Y. Their offices at New York and Chicago will be conducted as heretofore.

The Electrical Construction Company, of Baltimore, has been formed by C. W. Huntington, H. G. Lee, T. W. R. Devall and others to make electrical machinery and supplies, with a capital stock of $12,000.

Foolish Seafaring Folk.—According to the New York *Herald*, the propensity to blow out the gas is often found among seafaring people, who have to be closely watched in hotels, lest they commit involuntary suicide and cause explosions.

The Visual Signal Company, of New Haven, Conn., has written a letter to the Mayor of Minneapolis, offering to install 60 signal stations for $14,000, which sum, they claim, is $3,000 less than the sum named in the contract awarded to the Municipal Company, of Boston.

A "Conference" Proposed.—The *Morning Journal* has canvassed the New York members of the State Legislature as to "legislation for controlling the electric currents along our streets within the limits of safety," and has invited them to join in a conference on the subject.

The Kakabikka Falls, a magnificent water power near Port Arthur, Ont., is to be developed electrically and otherwise by Dr. A. M. E stman, of St. Paul; R. J. Anderson, of Minneapolis, and others. A large amount of capital is behind the scheme. The river is 350 feet wide, with a perpendicular fall of 100 feet, and 200,000 h. p. is counted upon.

American Institute Awards.—Among the awards granted to electrical exhibitors at the American Institute Fair, now being held in this city, are medals to the following: The Schuyler Electric Light Company, the Mather Electric Company, the Continental Dynamo Company, the Wenstrom Dynamo Company. The jury of awards was composed of Messrs. C. O. Mailloux, F. B. Crocker, O. A. Moses, A. A. Knudson and J. Case.

The Location of the Soul.—The soul, says Dr. A. H. Stevens, of Philadelphia, is located in the corpus callosum, a little spongy body situated at the base of the brain, which has defied the efforts of physicians in their endeavors to ascertain its uses in the human anatomy. "The corpus callosum," said the Doctor, "is the seat of the imperishable mind, and is the great reservoir and storehouse of electricity, which is abstracted from the blood in the arteries, and conveyed through the nerves up the spinal cord to the corpus callosum."

Schenectady, N. Y.—The Edison Machine Works already employ some 1,300 men, and when the extensions are completed probably twice that number will be required. A one-story brick building, 402 × 72 feet, is now being erected, and in it will be made all kinds of wire. A new three-story brick building, 167 × 50, will be used for carpenter shop, pattern shop, etc. The present wire works will be used for machine work. The company also has under contract a new brass foundry, an iron foundry and, it is said, a building for the manufacture of glass globes.

Electricity to Keep and to Kill Prisoners.—A dispatch from Madison, Fla., says that a prisoner, under sentence of death, escaped with several others from the local jail by filing through bars supposed to be file proof. Electricity ought to be used to guard prisoners in small jails, where the number of keepers is necessarily limited. An electric alarm could be attached to each bar that would signal any break in the bar, or could be adjusted so as to sound an alarm as soon as the cross section of a bar had been materially reduced.—*Phila. Ledger.*

New York Magnetic Club.—Mr. James D. Reid has been appointed American Consul at Dunfermline, Scotland, for which place he will leave New York Nov. 27. This club desiring to do him honor will entertain him at dinner at Martinelli's, 136 Fifth Avenue, at 6.30 P.M., Nov. 20. The New York Telegraph Club will on this occasion participate, and as the dinner will be held on the date of the annual meeting of the Telegraphers' Mutual Benefit Association, the delegates to that meeting will also join. The occasion will be a most interesting and memorable one.

American Institute of Electrical Engineers.—At the monthly meeting of the Institute, which will be held on Tuesday, Nov. 19, at 8 o'clock P. M., in Dr. Doremus' Lecture Room, College of the City of New York, No. 17 Lexington avenue, S. E. corner Twenty-third street, papers will be read by Mr. Charles J. Reed, on the "Form and Efficiency of Incandescent Filaments," and by Mr. P. B. Delany, on "Telegraph Line Adjustment" and "A New Gravity Cell." A practical demonstration of the line adjustment system will be made with suitable apparatus.

The American Society of Mechanical Engineers will hold its meeting in this city during the present week, when an interesting programme of papers will be presented. The professional sessions will be held in the New York School of Medicine, 12 West Thirty-first street. There will be a reception at the society's new rooms, 64 Madison avenue, on Nov. 18; a reception will also be given at the Engineers' Club on Nov. 20, and there will be other entertainments. The local committee are S. W. Baldwin, J. F. Holloway, F. R. Hutton, C. Kirchhoff and W. H. Wiley.

Obituary: Louis Curchod.—The death is announced of M. Louis Curchod, director of the Bureau International des Administrations Telegraphiques, at Berne, Switzerland, on Oct. 18, at the age of 63. M. Curchod after graduating from the Ecole Centrale, des Arts et Manufactures of Paris in 1849, devoted himself to telegraphy, and was soon in the entire charge of the Swiss telegraphs. When the Bureau was organized, M. Curchod was placed at its head, which position he held at the time of his death. M. Curchod was the recipient of many honors at the hands of foreign governments.

"Fortschritte der Elektrotechnik."—We learn with regret that it is proposed to discontinue this most valuable publication on account of the lack of support accorded it. This work, it will be remembered, is a complete index in German of periodical electrical literature, to which is added an abstract of all the more important articles. We have found this work to be of the utmost value, and we are certain that if but half its merits were known would be found on the work table of every electrician and electrical engineer. We hope, for the benefit of the profession, that its publication will be continued, if not quarterly, at least annually.

Underground Wires in Philadelphia.—City Council's Law Committee has again fixed a date for the removal of overhead wires, but this time it has arranged a graduated scale to guide the companies in obeying the law. This schedule, which was adopted last week, is as follows: All electric light wires between Vine and South streets and the two rivers must be underground by Dec. 1, 1890; between South street and Washington avenue, Vine street and Girard avenue, and Gray's Ferry and Girard avenue, West Philadelphia, by Dec. 1, 1891; and all other parts of the city except the rural sections by Dec. 1, 1892. To bury the telegraph and telephone wires the companies are given a year's more time in each district than with the electric light wires, so that it will be Dec. 1, 1893, before the wires in the outskirts of the city go underground. There are now in the city 10,324 telegraph, telephone and electric light poles, of which 4,649 are owned by the city and 5,675 by various companies. Up to the present time 825 miles of wire have been placed underground, but over 5,000 still remain overhead.

Electricity Direct from Fuel.—Prof. John Perry says on this subject: "I pointed out in 1881 that if coal or gas were burnt in a voltaic cell as zinc is burnt, and an electro-motor were used, we could utilize as mechanical energy not merely one-tenth, but nearly nine-tenths, of the energy of coal. I pointed out then that coal gas could be burnt in this way, but there were two difficulties—1st, the apparatus required was too large per horse power developed; 2d, the apparatus required was too expensive. The first of these difficulties has already been got over by a correspondent, who is in some sense my partner. We see our way to developing one useful horse power per cubic foot of volume of apparatus. Unfortunately, the difficulty of expense still remains. But I am firmly convinced, and I have good reason for my belief, that all the difficulties will be got rid of, and that coal will actually be burnt in this way. Even to those of you who may not be troubled about the general question of economy, the mere possibility of an armor-clad being able to carry enough coal for a voyage at full speed round the world must appear to be an important result."

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y.. No. 105 South Warren street.

The Pratt & Whitney Company, of Hartford, Conn., issue a catalogue of over 300 pages, which should be in the hands of all who use or who require high class machines and tools. Nearly all the pieces described and illustrated are kept in stock, and can be furnished at short notice. One can now visit electrical factories and see Pratt & Whitney tools on every hand. They are pointed out with no small pride by the proprietors and workmen.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK, General Office, 432 Fifth Avenue, New York, Nov. 7, 1889.

Mr. G. W. Galway.

DEAR SIR: I think if you call at the Berkeley Hotel you can sell a filter. I had the manager here to-day, and he thought it a great saving. I told him what I had done with it. I ran last month 1,048 hours, and used 64 gallons of oil; how does that favor the filter? I should be pleased to recommend it anywhere.

Yours respectfully,

A. S. ROSEBERRY,
Chief Engineer, 47 West 26th street,
Edison Elec. Ill. Co.

The Williams Engine Works and the Eclipse Wind Engine Co., of Beloit, Wis., have just closed contracts for steam engines and power transmitting machinery with the Laclede Gas Light Company, St. Louis, and with the Detroit Electric Light and Power Company, in the fulfillment of which the first named company will furnish four engines, the horse power of which ranges from 150 to 350. The latter supply the rope sheaves, friction clutch pulleys, cut-off couplings, shafting, stands, etc. These two firms, each with a corps of experts, evidently intend to push their way to the forefront in the lines of steam engineering, designing, furnishing plans and contracting for the full equipment of plants with first-class engines and improved power transmitting accompaniments. No effort or expense has been spared in the way of equipment to make the Williams Engine Works one of the best factories in America for manufacturing steam engines. The plans of the buildings were furnished by the Flynt Building and Construction Company, of Palmer, Mass. The machinery is from the manufactories of Wm. Sellers & Company, Philadelphia; Brown & Sharpe Manufacturing Company, Providence, R. I.; Pond Machine and Tool Company, Plainfield, N. J.; Hendey Machine Company, Torrington, Conn.; Prentice Bros., Worcester, Mass.; Putnam & Sons, Fitchburg, Mass.; G. A. Gray, Cincinnati, O.; Beaman & Smith, Providence, R. I.; Niles Tool Works, Hamilton, O.; Edw. P. Allis & Co., Milwaukee, and others. The most notable feature of the outfit is the Shaw electric traveling crane, a huge machine that moves about overhead, able and ready, if need be, to pick up the locomotive that comes into the building and dump it at any point in the large area over which it moves. Though comparatively new, three of the Williams engines of 500 h. p. each have been doing work far in excess of their rated or guaranteed capacity for two years at the Chicago Arc Light and Power Company's station in Chicago. The conception and installation of these works is due to the fact that the Williams' triple expansion engine indicates a step forward toward the realization of the steam engineer's ideal, an engine that will evolve a horse power per hour for every pound of coal con-

sumed. So great is the success of this newcomer that the facilities for its manufacture will soon be doubled.

Houston's Electrical Dictionary.—The following are only a few of the many flattering notices of the Dictionary that have appeared, but they are fair samples of the others: *London Electrital Review*—"The name of the author is a sufficient guarantee of the excellence of the work." *Indianapolis Journal*—"The book contains all the technical terms and phrases now used by electrical scientists and inventors, with definitions and applications. It might be called an electrical cyclopedia." *New York Electrical Review*—"A comprehensive dictionary of electrical words and phrases is something that has been demanded since electricity first came into commercial importance, and with the increase in electrical literature in the last few years it is rather remarkable that not until the present time has the want been filled. It has been left for Edwin J. Houston, A. M., to compile the book, which is called a 'Dictionary of Electrical Words, Terms and Phrases,' and his work is such as to call for the highest commendation." *Merchant, Miller and Manufacturer*—"We have critically examined the work, and pride ourselves on being in a position to pass unbiased judgment upon the dictionary, for the reason that we purchased the book, paying good cash for the same, and secondly because we have made a study of electricity for the past ten years. The book contains over 650 pages, is copiously illustrated, printed on the best of paper, and from new type. The volume presents a handsome appearance—fit to adorn any library. As a book of reference and definition it can be said to meet the wants of the expert as well as of the student, as everything in the electrical world is covered. *Practical Electricity*—By far the most useful book ever printed on this continent for the benefit of electrical students." *Omaha Bee*—"The marvelous progress of electricity in the industries of the country makes the dictionary especially valuable as a work of reference. It is not a mere word book. The words, terms and phrases are invariably followed by short, concise definitions, giving the sense in which they are correctly employed, with copious illustrations of electrical appliances." *Philadelphia Times*—"In this age of common and almost universal use of electricity a dictionary of electrical terminology becomes a necessity. Professor Houston's work is very carefully prepared, and it will be found useful both by electrians and the general public. *Electric Power*—"It is fair to presume that the need of such a work was first appreciated both in the class-room and the editorial sanctum, and it is fitting that the production of the book should have been undertaken by the professor and the editor, laboring both separately and jointly. In the small collection of books which we have within reach, it occupies that place on our desk corresponding with the "e" box of the printer's case, to be used most frequently, and therefore the most convenient of access."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED NOV. 12, 1889.

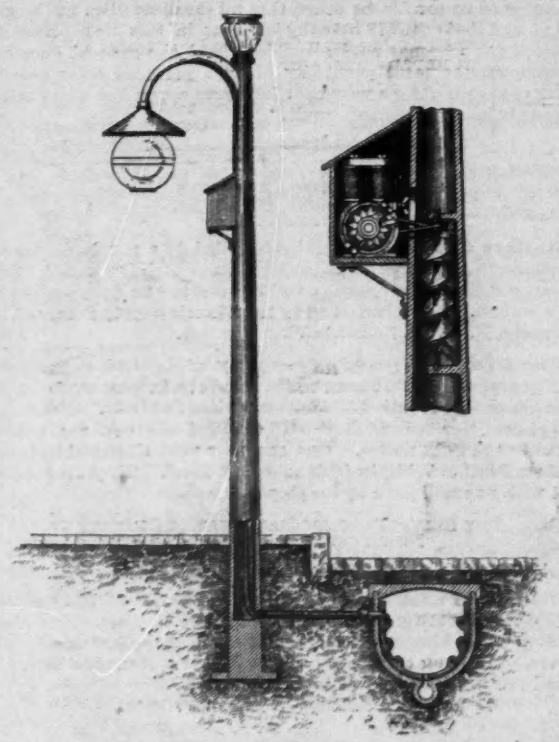
414,695. Electro Mechanical Tripping Machine; Thomas F. Gaynor, of Louisville, Ky., Assignor to the Gaynor Electric Co., of same place. Application filed Sept. 2, 1889. The essential principle embodied in the device is to permit of having a comparatively heavy weight locked up by the detent lever, and yet so arrange the leverage upon the lever as to minimize the pressure of the catch end of the lever upon the seats forming the catch of the armature fork, so that a minimum of battery power will, through the magnet, trip the weight free to drop and accomplish the purpose intended.

414,714. Electric Heater; Michael B. Leonard, of Richmond, Va. Application filed July 9, 1889. The heater comprises a box or case which is filled with some insulating heat retaining material, in which there is embedded a conductor of high specific resistance, or a "heating resistance." When this conductor is coupled up in circuit with a generator of electricity, the heat developed will be conducted to the radiating surface of the box or case, and thence dissipated into the atmosphere, thereby affording a source of heat which can be regulated with great ease and nicety, and which is capable of wide ranges of temperature. See illustration.

414,741. Incandescent Electric Lamp; George Warren Wilson, of Boston, Mass. Application filed Jan. 24, 1889. In combination with an incandescent electric lamp, a non-conducting transparent reflector in tubular form interposed between the limbs of the filament.

414,742. Incandescent Electric Lamp; George Warren Wilson, of Boston, Mass. Application filed Jan. 25, 1889. In an incandescent electric lamp having a transparent globe, a non-conducting reflector supported between the limbs of the filament of the lamp, the reflector being colored or tinged.

414,757. Electric Fan-Motor; Philip Diehl, of Elizabeth, N. J. Application filed June 20, 1889. The combination, with the supporting bracket of the stationary field magnet attached thereto, the rotary armature and the vertical fan carrying shaft, to the top of which the armature is secured, and which has all of its vertical bearings in the supporting bracket below the point of attachment of the armature, the shaft having a hub resting



415,110.—Method of Ventilating Subways.

against a horizontal bearing of the supporting bracket. See The Electrical World, June 29, 1889.

414,758. Electric Motor Fan; Philip Diehl, of Elizabeth, N. J. Application filed Aug. 12, 1889. The combination, with the armature of an electric motor, a shaft to which the armature is attached, and a support in which the shaft has its bearings, of a field magnet consisting of a single continuously wound core or body, and a support from which the magnet is suspended and which is separate from, but detachably connected with, the support for the armature shaft.

414,763 Automatic Circuit Making and Breaking Mechanism for Gas Lighting; Willard W. Esterbrook, of Boston, Mass. Application filed Feb. 27, 1889. Consists of a central automatically operating circuit maker and breaker by the operation of which electrical connection is established with a number of secondary automatically operating circuit makers and breakers, each located in a given district of the city and connected with the lights in the district, and by the operation of which the lights are lighted and extinguished.

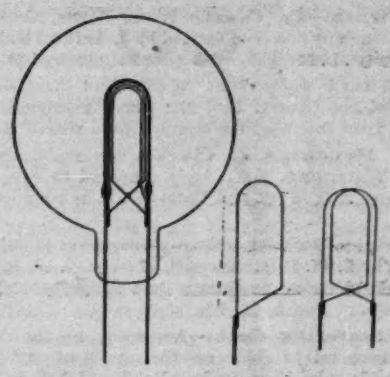
414,773. Electric Railway Signal; William P. Kookogey, of Brooklyn, N. Y., Assignor to the Kookogey Electric Company. Application filed March 15, 1887. In combination with a track signal and with a hand lever or equivalent device connected with and located at a distance from, or out of sight of, the signal for setting the same, an electric circuit including a section of the railway track and a lamp or signal, the latter in proximity to the hand lever, the circuit being adapted to be short-circuited to cut out the lamp or signal when a train enters upon a section of the track previously constituting a part of the circuit.

414,792. Cut-Out for Incandescent Lamp; Turner D. Bottome, of New York, N. Y., Assignor to John B. Tibbitts, of Hoosick, N. Y. Application filed June 25, 1889. An alternating current cut-out consisting of an incandescent lamp filament and two metallic loops of the same shape as the filament, one loop being electrically connected to one, and the other loop to the other, terminal of the filament, and all placed closely together. See illustration.

414,860. Electric Current Indicator; Jacob F. Mehren, of Chicago, Ill. Application filed Jan. 26, 1889. It consists in a compass having a pointer connected with and extending between the extremities of the poised magnetic needle, and having wire wound around the case in two or more turns, which are spread apart across the top of the case to avoid obstructing the view of the needle.

414,866. Clamp for Holding Articles to be Electroplated; William A Dunlap, of Pittsburgh, Pa. Application filed July 27, 1889. An electroplating clamp having in combination side bars connected at one end and movable toward and from each other, a detachable clamp at the opposite end, and a series of inward projections dividing the clamp into a series of compartments.

414,866. Electric Indicator; Frank E. Morgan, of New Haven, Conn., Assignor to the New Haven Clock Company, of same place. Application filed April 5, 1889. A variable signal transmitter having a dial, an indicator, a magnet, a circuit controller and a circuit interrupter hinged to the instrument, so as



414,792.—Cut-Out For Incandescent Lamps.

to be swung over and away from the dial, and cutting the circuit controller into, and out of, an electric circuit.

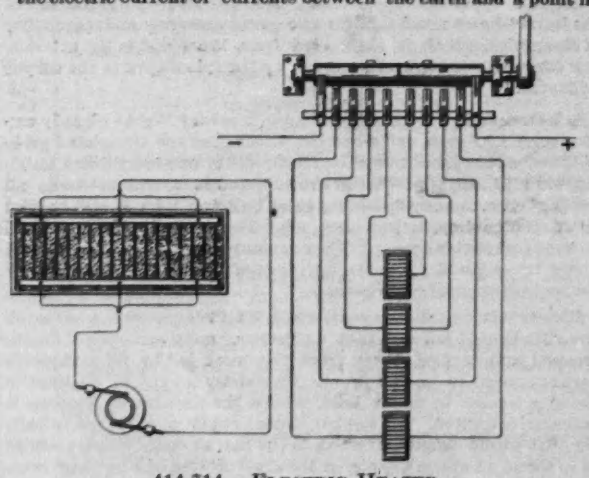
414,879. Electric Indicator; Daniel W. Edgecomb, of N. Y., and Charles A. Terry, of Whitestone, Assignors to the Porter Electric Messenger Company, of New York, N. Y. Application filed Oct. 8, 1885. The object of the invention is to provide reliable, simple and efficient means for transmitting the required signals to the central office, insuring that the signals shall be received in their proper order, and that one signal or call shall be attended to before another is received.

414,883. Alarm Attachment for Gas-Burners; Eugene L. Harrison, of Ashland, Wis. Application filed April 24, 1889. In an electric alarm attachment for gas-burners, a vibratory circuit closer located in such juxtaposition to the burner as to be actuated by a draft against the latter.

414,900. Dynamo Electric Machine; Heinrich Geisenhöner, of Schenectady, N. Y. Application filed June 5, 1889. The invention consists in a dynamo formed of a frame having four loops in which are arranged the field magnet cores with their windings, the cores being provided with polar extensions projecting on opposite sides of the machine.

414,922. Incandescent Lamp Socket; Samuel Rodman, Jr., of the United States Army. Application filed Feb. 19, 1889. The combination, with a series of light-producing agents, of a switch cylinder provided with a continuous spiral contact plate, spring tongues which bear against the cylinder, and connections between the tongues and the light-producing agent.

414,943. Method of Utilizing Natural Electric Energy; Mark W. Dewey, of Syracuse, N. Y., Assignor to the Dewey Corporation, of same place. Application filed May 1, 1889. The method of utilizing atmospheric electric energy, consisting in conducting the electric current or currents between the earth and a point in



414,714.—Electric Heater.

the atmosphere at an elevation above the earth, rectifying or straightening the currents during transit, and storing or accumulating the electrical energy of the rectified current. See illustration.

414,953. Secondary Battery; William Roberts, of Toronto, Ontario, Canada. Application filed June 17, 1889. The invention consists in an electrode formed of plates which have a number of openings extending through the same from side to side, and the inner side of each plate between the openings beveled, inclined, rounded, or otherwise so formed that two plates when brought together face to face will be out of contact and have more or less open space between them, except along the apex of the material between the openings, and from which point the material slopes or recedes to the openings in lines at less than a right angle to the plane of the outer sides of the plates.

414,961. Telephone Support; Horace M. Wilson, of Cambridge, Mass. Application filed Aug. 29, 1889. The invention consists of an improved holder or support for the receiver of a telephone when in use, whereby it may rest against the ear of the person receiving the message without being held in the hand.

414,966. Mechanical Cut-Out; Joseph W. Battershall, of Attleboro, Mass. Application filed May 4, 1889. The invention consists in the construction by which four insulated metallic sections, each provided with a binding post, are held in contact with two metallic segments insulated from each other, which form the bridge between the two pairs of the four sections, and which by a partial revolution will change the direction of the current without breaking contact.

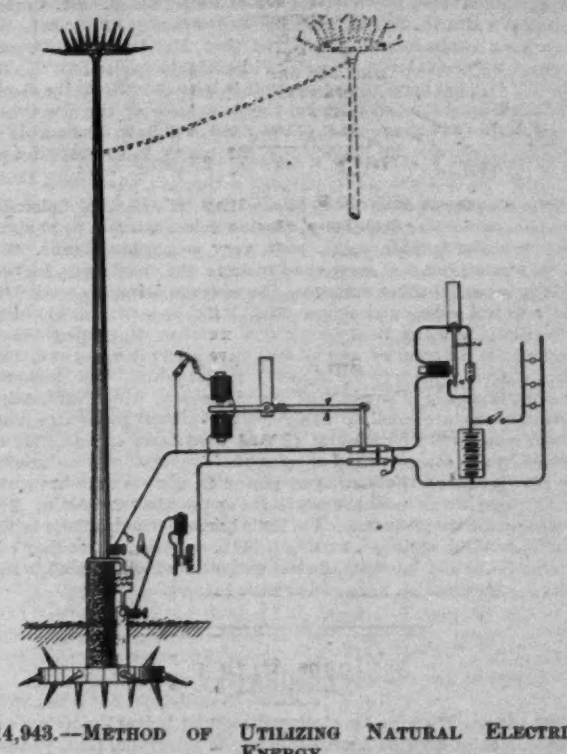
414,970. Conduit for Underground Wires; Horace B. Camp, of Cuyahoga Falls, O. Application filed Aug. 12, 1889. The combination of a larger and smaller section of pipe, the smaller adapted to enter the larger pipe, the larger pipe provided with internal ridges to support the smaller pipe.

414,996. Combined Electro-Magnetic Brake and Traction Increasing Device; Elias E. Ries, of Baltimore, Md., Assignor by direct and mesne assignments to Ries & Henderson, of same place. Application filed Dec. 28, 1887. The invention consists, essentially, in establishing two independent self-contained electric circuits, traveling with the vehicle or train, approximately of equal resistance and fed by a single source of electricity, one of said circuits including magnetizing coils so arranged in inductive proximity to each pair of brake shoes as to produce magnetism of opposite polarity, respectively, therein by the passage of a current of electricity therethrough, and the other electric circuit, including magnetizing coils so arranged in inductive proximity to each axle of the vehicle carrying a pair of wheels that a closed magnetic circuit is completed through the axles, wheels and intervening track rails, and the successive wheels of the vehicle are converted into poles of opposite polarity.

415,024. Apparatus for Obtaining Sheets of Metal by Electro Deposition; Charles C. Coffin, of Boston, Mass. Application filed Jan. 10, 1889. The combination with the receptacle or bath having a central post or pedestal and provided with anodes, of the cathode cylinder disposed in the receptacle or vat, and radial arms having their outer ends engaging lugs upon the cylinder at its upper edge, the arms having their central hub portion supported through a pivot and bearing-head upon the post or pedestal and coupled to a driving shaft.

415,070. Electric Motor Support; Sidney H. Short, of Columbus, O. Application filed Jan. 26, 1889. In combination with the truck of a car and the axles thereof, a motor supported between the side walls of a frame, the frame being pivoted at one end to the axle of the car, and a cushion beneath the motor between it and the car truck.

415,110. Method of Ventilating Subways; Isaac La Rue Johnson, of Washington, D. C., Assignor of one-half to Oliver T. Thomson, of same place. Application filed July 9, 1889. It consists in mechanism for and the method of ventilating conduits and



414,943.—Method of Utilizing Natural Electric Energy.

subways by suitable mechanism connected with the lamp mast of an electric light lamp, whereby the tubular form of the mast is made available as an exhaust pipe and as a conduit for conveying a current of electricity from the main conduit or subway to a motor for driving a suitable exhaust fan; and it further consists in so constructing and adjusting the exhaust fan as to prevent a down draft through the lamp mast, thus preventing the admission of the external air through the mast, which thereby prevents the discharge of the foul or damp air from the conduit, and thereby preventing explosions, which occur therein when the atmospheric air mingles with illuminating and other gases which find access to the conduits and their man-holes. See illustration.

415,165. Electric Locomotor; Joseph R. Finney, of National City, Cal., Assignor by mesne assignments of one-half to the Overhead Conductor Electric Railway Company, of Pittsburgh, Pa. Application filed Aug. 17, 1886. The combination, with the running gear of a railway car, of an electric motor carried upon the car, and a reversing friction gear interposed between the motor shaft and the wheels of the car whereby the latter may be driven in either direction without reversing the directing of rotation of the motor shaft.

415,182. Annunciators; Albert T. Hess, Des Moines, Iowa. Application filed Dec. 9, 1887. The annunciator shield carries two arms which embrace the heads of the magnet, and are pivotally mounted on the ends of the extended core of the magnet.

PATENT EXPIRED NOV. 19, 1889.

133,235. Improvement in Automatic Telegraph Apparatus; George Little, of Rutherford Park, N. J. A roller is made with two grooves or drums for strips of paper; one grooved drum is for the perforated transmitting strip, and the other is for the chemical receiving strip. Two hinged levers are provided, each with a pressure spring, contact roller, and guiding brush, and one has the transmitting stylus or rollers, the other the recording stylus or pen. One of these levers is lifted when the other is depressed, and the circuit connections are to the drum that is insulated and to the frame carrying the levers, so that whichever lever and stylus is depressed will be operative.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.